070-7234-00
Product Group 41

2211
DIGITAL STORAGE OSCILLOSCOPE
SERVICE

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. REFER TO OPERATORS SAFETY SUMMARY AND SERVICE SAFETY SUMMARY PRIOR TO PERFORMING ANY SERVICE.

Please Check for
CHANGE INFORMATION
at the Rear of This Manual

First Printing APR 1990

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INSTRUMENT SERIAL NUMBERS

Each instrument has a serial number on a panel insert, tag, or stamped on the chassis. The first number or letter designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument. Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

B000000	Tektronix, Inc., Beaverton, Oregon, U.S.A.
HK00001	Hong Kong
100000	Tektronix Guernsey, Ltd., Channel Islands
200000	Tektronix United Kingdom, Ltd., Marlow
300000	Sony/Tektronix, Japan
700000	Tektronix Holland, NV, Heerenveen, The Netherlands

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OPERATORS SAFETY SUMMARY

The safety information in this summary is for operating personnel. Warnings and cautions will also be found throughout the manual where they apply.

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.

Terms as Marked on Equipment

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

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

Symbols in This Manual

⚠ This symbol indicates where applicable cautionary or other information is to be found. For maximum input voltage see Table 1-1.

Symbols as Marked on Equipment

ϟ DANGER — High voltage.

⏚ Protective ground (earth) terminal.

⚠ ATTENTION — Refer to manual.

Power Source

This product is intended to operate from a power source that does not apply more than 250 V 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 making any connections 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 Figure 2-2.

Use the Proper Fuse

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

Do Not Operate in an Explosive Atmosphere

To avoid explosion, do not operate this instrument in an explosive atmosphere.

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.

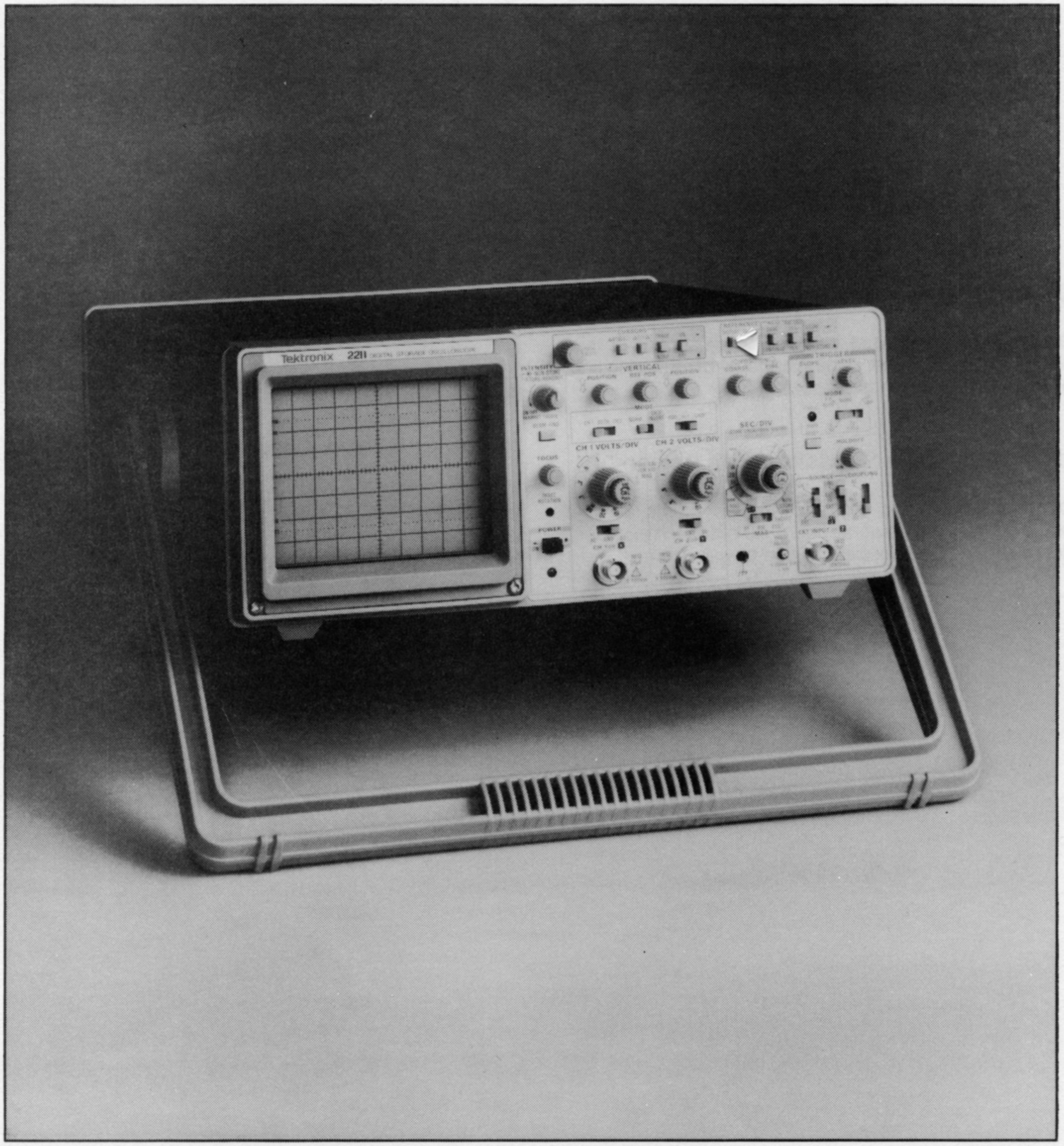
Use Care When Servicing With Power On

Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections or 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 does not apply more than 250V rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding connector in the power cord is essential for safe operation.



7234-46

The 2211 Oscilloscope.

SPECIFICATION

INTRODUCTION

The TEKTRONIX 2211 is a combination analog and digital storage portable oscilloscope. It has dual vertical input channels with an analog bandwidth of DC-to-50 MHz and a digital bandwidth of DC-to-10 MHz, and a CRT readout and cursor measurement display.

Vertical

The vertical channels have calibrated deflection factors from 5 mV to 5 V per division at full bandwidth. A vertical magnification feature on each vertical channel extends the maximum sensitivity of the magnified channel to 500 μV per division. Vertical magnification also reduces the bandwidth to 5 MHz and may be used as a bandwidth limiter affecting only the magnified channel. The Variable VOLTS/DIV gain control increases the vertical deflection factor up to 2.5 times the VOLTS/DIV switch setting.

NON-STORE. Vertical channel display modes are CH 1, CH 2, and BOTH. BOTH permits the added choices of ADD, ALT or CHOP display of the two channels. ALT display switches between traces at the end of each sweep, showing each waveform alternately; CHOP switches between the two input signals as the sweep is occurring to display both simultaneously on the crt. ADD algebraically sums the CH 1 and CH 2 input signals.

Horizontal

STORE. The vertical channel display modes are again CH 1, CH 2, and BOTH. With BOTH Vertical MODE, CH 1 and CH 2 are digitized simultaneously. The only exception to this is if the Vertical MODE is ALT and the Trigger MODE is VERT MODE; then, CH 1 and CH 2 are digitized alternately. ADD also functions in STORE mode.

NON-STORE. The horizontal deflection system has calibrated sweep speeds from 0.5 s to 0.05 μs per division. The Variable SEC/DIV control may be used to increase the sweep time per division up to 2.5 times the calibrated time per division set by the SEC/DIV switch. The X1, X10, X50 Magnifier switch expands the horizontal display by 1, 10 or 50 times around the center vertical graticule line.

STORE. In STORE mode, the normal calibrated sweep speeds are from 0.5 s to 20 μs per division. At sweep speeds of 20 μs to 50 ms per division, the digitized display is updated as a full RECORD where all the waveform data points are refreshed at the end of an acquisition period. At STORE mode sweep speeds of 0.1 s to 0.5 s, the display is updated in ROLL mode. In ROLL mode, the waveform is continuously digitized without regard to a trigger signal (except in triggered single-sweep mode). New data points are displayed by shifting the old waveform left to make room for the new data points as they occur. In single-sweep mode with a trigger signal, one RECORD of waveform data is digitized, then the acquisition stops. If the single-sweep is untriggered, the acquisition continues. At sweep speeds of 10 ms per division and slower, the 100X SEC/DIV multiplier can be enabled by removing the Variable SEC/DIV control from the CAL position. This extends the calibrated sweep speeds over the range of 1 s to 50 s.

Storage Sampling

The maximum sampling rate (digitizing speed) is 20 megasamples per second. A waveform record has 4096 data points (4 Kbytes) per channel for single-channel and dual-channel acquisitions. Waveform acquisition is the digitizing and storing of digital values that represent the analog waveform applied to the vertical input. The complete 4K waveform record is displayed on screen with 400 points per division resolution.

One waveform set (either channel or both) may be stored in the 8K reference memory. When storing new waveform data into the reference memory, previous data is overwritten. The stored reference waveforms may be recalled for analysis or comparison with a newly acquired waveform. The X1, X10, X50 MAG switch functions on the stored reference-waveform displays, and they may be expanded horizontally 10 or 50 times. The REFERENCE POSITION control may be used to reposition the reference waveform display upward from the position at which it was acquired.

Cursor Readout Display

The cursor readout display reports the setting of the CH 1 and CH 2 VOLTS/DIV switches, the SEC/DIV switch, the Voltage and Time cursor separation, the Trigger Level and position of the Trigger COUPLING switch, and the AC position of the AC-GND-DC switch to the user. Parametric information for the waveform display is therefore visible when oscilloscope photography is used to maintain a permanent record of a display of interest. An additional readout area is reserved for STORE mode, SAVE/CONTINUE, and ROLL mode status.

Voltage or time measurements may be made on the displayed waveforms using cursors. The cursors should be positioned on the desired measurement points, e.g. on the waveform peaks for a peak-to-peak measurement. The ΔV, Δt or 1/Δt crt readouts indicate the voltage difference, timing difference or reciprocal time-difference respectively, between the positions of the cursors.

Serial Interface

The serial interface is fitted to the 2211 digital storage oscilloscope to permit the transmission of waveform data to RS-232C compatible equipment including printers, plotters and computers.

Asynchronous serial communications at baud rates of 300, 1200, 4800, or 9600 are supported with a fixed serial data format of 8 data bits, one start bit, one stop bit and no parity.

STANDARD ACCESSORIES

The following standard accessories are provided with each instrument:

2	10X, P6109 Probe packages
1	Power Cord and Fuse
1	Operator's Manual
1	User Reference Guide
1	Loop Clamp
1	Flat Washer
1	Self-Tapping Screw

Refer to the Accessories page at the back of this manual for part numbers and further information about both standard and optional accessories. Available options are described in Section 7. Your Tektronix representative, local Tektronix Field Office, or Tektronix products catalog can provide additonal information on options and accessories

FOR MORE INFORMATION

Should you need additional information about your 2211 Oscilloscope or about other Tektronix products: contact the nearest Tektronix Sales Office or Distributor, consult the Tektronix product catalog. In the United States, you may call the Tektronix National Marketing Center, toll free at 1-800-426-2200.

RECOMMENDED CALIBRATION SCHEDULE

To ensure accurate measurements, check the performance of this instrument every 2000 hours of operation, or, if used infrequently, once each year. Replacement of components in the instrument may also make it necessary to readjust the affected circuits.

PERFORMANCE CHARACTERISTICS

Performance characteristics for the 2211 Oscilloscope are given in tabular form in Tables 1-1, 1-2, and 1-3. The tables list specifications for the instrument's electrical characteristics, its environmental operating limits, and the physical dimensions and weight of the instrument.

Table 1-1

Electrical Characteristics

Characteristics	Performance Requirements
VERTICAL DEFLECTION SYSTEM	
Deflection Factor	
Range	5 mV per division to 5 V per division in a 1-2-5 sequence. Sensitivity increases to 500 µV per division in X10 mag.
DC Accuracy	X1: ±3%; X10: ±5%. For 5 mV per division to 5 V per division the gain is set with the VOLTS/DIV switch at 5 mV per division.
Storage Acquisition	
Vertical Resolution	8-bits, 25 levels per division.
Dynamic Range	10.24 divisions.
Range of Variable VOLTS/DIV Control	Continuously variable between settings. Increases deflection factor by at least 2.5 to 1.
Step Response (NON-STORE Mode)	
Rise Time	
5°C to +35°C	
5 mV per division to 5 V per division	7.0 ns or less.
0°C to +40°C	
5 mV per division to 5 V per division	8.8 ns or less. Rise time is calculated from this formula: $\text{Rise Time} = \frac{0.35}{\text{Bandwidth (-3 dB)}}$
Step Response (STORE Mode)	
Useful Storage Rise Time	$\frac{\text{SEC/DIV X 1.6}}{400}$ s. Rise time is limited to 35 ns minimum.
Aberrations (NON-STORE and STORE)	At +25°C with cabinet installed.
5 mV per division	6% or less.
10 mV per division to 0.2 V per division	4% or less.
0.5 V per division	6% or less.

Table 1-1 (cont)

Characteristics	Performance Requirements
NON-STORE Bandwidth (-3 dB)	
5°C to +35°C	
5 mV per division to 5 V per division	DC to at least 50 MHz.
0°C to +40°C	
5 mV per division to 5 V per division	DC to at least 40 MHz. Measured with a vertically centered six-division reference signal, from a 50 Ω source driving a 50 Ω coaxial cable terminated in 50 Ω at the input connector and the VOLTS/DIV Variable control in the CAL detent.
X10 MAG Bandwidth (-3 dB)	DC to at least 5 MHz.
AC Coupled Lower Cutoff Frequency	10 Hz or less at -3 dB.
Useful Storage Performance	
20 μs per division to 50 s per division	$\frac{20}{\text{SEC/DIV}}$ Hz. Useful storage performance is limited to the frequency where there are 20 samples per sine wave signal period at the maximum sampling rate. This yields a maximum amplitude uncertainty of 5% (maximum sampling rate is 20 MHz). Accuracy at useful storage performance limit is measured with respect to a 6 division, 50 kHz reference sine wave.
EXT CLOCK (up to 10 MHz)	EXT/20 Hz.
NON-STORE CHOP Mode Switching Rate	500 kHz ±30%.
A/D Converter Linearity	Monotonic with no missing codes.
Input Characteristics	
Resistance	1 MΩ ±2%.
Capacitance	25 pF ±2.0 pF.
Maximum Safe Input Voltage ⚠	
DC and AC coupled	400 V (dc + peak) or 800 V ac p-p at 10 kHz or less. See Figure 1-1 for maximum input voltage vs. frequency derating curve.

Table 1-1 (cont)

Characteristics	Performance Requirements	
Common-Mode Rejection Ratio (CMRR)	Checked at 5 mV per division for common-mode signals of six divisions or less with VOLTS/DIV Variable control adjusted for the best CMRR at 50 kHz.	
NON-STORE	At least 10:1 at 20 MHz.	
X10 MAG	At least 10:1 at 1 MHz. (Checked at 500 μV setting).	
STORE	At least 10:1 at 10 MHz.	
X10 MAG	At least 10:1 at 1 MHz. (Checked at 500 μV setting).	
Input Current	Less than 0.2 nA (0.1 division or less trace shift) at 25 ° C with the cabinet installed, with the input shorted to ground.	
Position Control Range	±10.5 divisions at 25° C.	
Trace Shift with VOLTS/DIV Switch Rotation	0.25 divisions or less; Variable VOLTS/DIV control in CAL detent.	
Trace Shift as the VOLTS/DIV Variable control is rotated	1 division or less.	
Trace Shift with INVERT	1.5 divisions or less.	
Trace Shift with X10 MAG	2.0 divisions or less.	
NON-STORE Channel Isolation	Greater than 100:1 at 10 MHz.	
STORE Channel Isolation	Greater than 100:1 at 10 MHz.	
TRIGGERING SYSTEM		
Trigger Sensitivity		
P-P AUTO and NORM	**5 MHz**	**50 MHz**
Internal	0.35 div	1.0 div
External	40 mV p-p	150 mV p-p
	External trigger signal from a 50 Ω source driving a 50 Ω coaxial cable terminated in 50 Ω at the input connector.	
TV LINE	**Internal**	**External**
	0.35 div	40 mV p-p
TV FIELD	1 division of composite sync.	
P-P AUTO Lowest Usable Frequency	20 Hz with 1 division internal or 100 mV p-p external.	

Table 1-1 (cont)

Characteristics	Performance Requirements
EXT INPUT Maximum Input Voltage ⚠	400 V (dc + peak ac) or 800 V ac p-p at 10 kHz or less. See Figure 1-1 for maximum input voltage vs. frequency derating curve.
Input Resistance	1 MΩ ± 10%.
Input Capacitance	25 pF ± 2.5 pF.
LEVEL Control Range (NORM Trigger Mode) Internal Trigger	May be set to any voltage level of the trace that can be displayed.
EXT, DC Coupling	At least ± 1.2 V, 2.4 V p-p.
EXT/10, DC Coupling	At least ± 12 V, 24 V p-p.
Variable HOLDOFF Control	Increases Sweep holdoff time by at least a factor of 8, with the SEC/DIV switch set to 1 ms.
AC Coupled Lower Cutoff Frequency Internal Source	10 Hz or less at -3 dB.
External Source	20 Hz or less at -3 dB.
LF REJECT Lower 3 dB Point	30 kHz ± 25%
HF REJECT Upper 3 dB Point	30 kHz ± 25%
DC Coupled Bandwidth	Dc to full vertical bandwidth.
Acquisition Window Trigger Point 25% PRETRIG	25% of the waveform acquisition window is prior to the trigger.
75% PRETRIG	75% of the waveform acquisition window is prior to the trigger.
HORIZONTAL DEFLECTION SYSTEM	
NON-STORE Sweep Rates Calibrated Range	0.5 s per division to 0.05 μs per division in a 1-2-5 sequence of 22 positions. The X10 magnifier extends maximum sweep speed to 5 ns per division.
STORE Mode Ranges RECORD	20 μs per division to 50 ms per division.
ROLL	0.1 s per division to 0.5 s per division; 1 s per division to 50 s per division in 100X.

Table 1-1 (cont)

Characteristics	Performance Requirements		
NON-STORE/STORE Accuracy	**X1**	**X10**	**X50**
+15°C to + 35°C	± 3%	± 4%	± 5%
0°C to + 40°C	± 4%	± 5%	± 8%
	Sweep accuracy applies over the center eight divisions. Exclude the first 50 ns of the sweep for X10 magnified sweep and the first 100 ns of the X50 magnified sweep. Exclude anything past the 10th division of unmagnified sweeps.		
Horizontal POSITION Control Range	Start of the 10th division will position past the center vertical graticule line in X10 (100th division in X10 Mag, 500th division in X50).		
NON-STORE/STORE Sweep Linearity	**X1**	**X10**	**X50**
	± 5%	± 8%	± 9%
	Linearity measured over any two of the center 8 divisions. Exclude the first 50 ns of the X10 magnified sweep and the first 100 ns of the X50 magnified sweep. Exclude anything past the 10th division of the unmagnified sweep.		
Digital Sample Rate			
20 μs/div to 50 s/div	$\frac{400}{\text{SEC/DIV}}$ Hz.		
External Clock Input Frequency			
RECORD	DC to 10 MHz.		
ROLL	DC to 4 kHz.		
Digital Sample Rate	Equal to the input frequency.		
Duty Cycle	**LO (min)**	**HI (min)**	
RECORD	50 ns	50 ns	
ROLL	50 μs	125 ns	
Logic Thresholds			
LOW	0.7 V.		
HIGH	2.1 V.		
Maximum Safe Input Voltage ⚠	25 V (dc + peak ac) or 25 V p-p ac at 100 kHz or less. See Figure 1-2 for the maximum input voltage vs. frequency derating curve.		
Input Resistance	1 MΩ ±10%.		
Input Capacitance	25 pF ±2.5 pF.		
STORE Mode Resolution			
Acquisition Record Length	4096 data points.		
Waveform Acquisition Display	4095 data points (400 data points/div across the graticule area).		

Table 1-1 (cont)

Characteristics	Performance Requirements
Variable SEC/DIV Control Range	
NON-STORE	Continuously variable between calibrated settings of the SEC/DIV control. Extends the Sweep speeds by at least a factor of 2.5 times over the calibrated SEC/DIV switch settings.
STORE	At SEC/DIV switch settings between 0.5 s and 10 ms, when the Variable SEC/DIV control is removed from the detent position, the SEC/DIV setting is multiplied by 100 and the STORE display is set to ROLL. When the SEC/DIV switch is set to EXT CLK, the Variable SEC/DIV control selects the display mode as shown below.
Displayed Trace Length	Greater than 10 divisions.
Registration of Magnified and Unmagnified Traces	Registration of unmagnified trace with magnified trace aligned to the center vertical graticule line is better than 0.2 division.
DIGITAL STORAGE DISPLAY	
Vertical	
Resolution	8-bit (1 part in 256). Display waveforms calibrated for 25 points per division.
Differential Accuracy	Graticule indication of voltage cursor difference against readout value measured over the center six divisions.
15°C to 35°C	2 % of readout value.
0°C to 40°C	4 % of readout value.
Position Registration	
NON-STORE to STORE	Within ±0.5 division at graticule center at VOLTS/DIV switch settings from 5 mV/div to 5 V/div.
REFERENCE POSITION Control Range	At least +3 divisions.
Horizontal	
Digital Sweep	Calibrated to 400 points per division.
Expansion Range	1, 10 or 50 times as determined by the MAG switch.
Differential Accuracy	Graticule indication of time cursor difference against readout value measured over the center six divisions.
15°C to 35°C	2% of readout value.
0°C to 40°C	4% of readout value.

STORE display mode (Variable SEC/DIV at EXT CLK):

Variable Position	Display Mode	Frequency Range
CAL	RECORD	DC to 10 MHz
UNCAL	ROLL	DC to 4 kHz

Table 1-1 (cont)

Characteristics	Performance Requirements		
Position Registration			
NON-STORE to STORE	Sweep start between NON-STORE and STORE is within ± 0.5 division at a SEC/DIV switch setting of 1 ms/div. Measured within the first division.		
DIGITAL READOUT DISPLAY			
Cursors Accuracy			
Voltage Difference	Within ± 3% of the Δ V readout value, (± 5% in X10 MAG), measured over the center six divisions.		
Time Difference			
NON-STORE	**X1**	**X10**	**X50**
15° to 35°C	± 4%	± 5%	± 6%
0° to 40°C	± 5%	± 6%	± 9%
	Measured over the center eight divisions.		
STORE			
0° to 40°C	± 0.1% of unmagnified sweep.		
Cursors Resolution			
Voltage Difference			
STORE	100 points per division.		
NON-STORE	400 points per division of unmagnified trace.		
Trigger Level Readout Accuracy			
15° to 35°C	Within ± 0.3 division +5% of reading with less than 8 divisions vertical input signal.		
TRIGGER LEVEL			
Range	±10 divisions.		
Resolution	10 levels per division.		

Table 1-1 (cont)

Characteristics	Performance Requirements
X-Y OPERATION (X1 MAG AND NON-STORE ONLY)	
Deflection Factors	Same as vertical deflection system with the VOLTS/DIV Variable controls in the CAL detent positions.
Accuracy	
X-Axis	Measured with a dc-coupled, five-division reference signal. Within ± 5%.
Y-Axis	Same as vertical deflection system.
Bandwidth (-3 dB)	
X-Axis	Measured with a five-division reference signal. DC to at least 2 MHz.
Y-Axis	Same as vertical deflection system.
Bandwidth (-3 dB)	
X-Axis	Measured with a five-division reference signal. DC to at least 2 MHz.
Y-Axis	Same as vertical deflection system.
NON-STORE Phase Difference between X-Axis and Y-Axis Amplifiers	± 3° from dc to 150 kHz. Vertical Input Coupling set to dc.
PROBE ADJUST	
Output Voltage on Probe Adjust Jack	0.5 V ± 5%.
Repetition Rate	1 kHz ± 20%.
Z-AXIS	
Sensitivity (NON-STORE Only)	5 V causes noticeable modulation. Positive-going input decreases intensity.
Usable Frequency Range	DC to 5 MHz.
Maximum Safe Input Voltage	Same as External Trigger.
POWER SUPPLY	
Line Voltage Ranges	95 Vac to 128 Vac and 190 Vac to 250 Vac.
Line Frequency	48 Hz to 440 Hz.
Maximum Power Consumption	85 Watts (95 VA).
Line Fuse	
115 V operation	1 A, slow-blow.
230 V operation	0.5 A, slow-blow.

Table 1-1 (cont)

Characteristics	Performance Requirements
CRT DISPLAY	
Display Area	8 X 10 cm.
Standard Phosphor	P31.
Nominal Accelerating Voltage	12.6 kV.
SERIAL INTERFACE	
Serial Interface	Requirements comply electrically with EIA Standards RS-232C.
Baud Rates	300, 1200, 4800 or 9600.
Accuracy	< 1 error.
Serial Format	8 data bits. 1 start bit. 1 stop bit. No Parity.

Table 1-2

Environmental Specification

Characteristics	Performance Requirements
Temperature	
Operating	0°C to +40°C (+32°F to +93°F).
Nonoperating	-55°C to +75°C (-67°F to +167°F). Tested to MIL-T-28800C, para 4.5.5.1.3 and 4.5.5.1.4 (0°C operating test) except that in para 4.5.5.1.3, steps 4 and 5 are performed before step 2 (-55°C nonoperating test). Equipment shall remain off upon return to room ambient temperature during step 6. Excessive condensation shall be removed before operating during step 7.
Altitude	
Operating	To 4,500 meters (15,000 feet). Maximum operating temperature decreases 1°C per 1000 feet above 5,000 feet.
Nonoperating	To 15,000 meters (50,000 feet).
Humidity (Operating and Nonoperating)	5 cycles (120 hours) referenced to MIL-T-28800C para 4.5.5.1.2.2 for type III, Class 5 instruments. Operating and non-operating at 95% -5% to +0% relative humidity. Operating, +30° C to +40°C; nonoperating, -30°C to +60°C.
EMI	Meets radiated and conducted emission requirements per VDE 0871, Class B. Meets FCC section 15, sub part J, Class A.
Vibration, Operating	15 minutes along each of three major axes at a total displacement of 0.015 inch p-p (2.4 g at 55 Hz) with frequency varied from 10 Hz to 55 Hz to 10 Hz in one-minute sweeps. Hold for 10 minutes at 55 Hz in each of the three major axes. All major resonances must be above 55 Hz.
Shock, Nonoperating	30 g, half-sine, 11 ms duration, three shocks per axis each direction, for a total of 18 shocks.

Table 1-3

Mechanical Specification

Characteristics	Performance Requirements
Weight	
With Power Cord	8.15 kg (18.0 lb).
Domestic Shipping Weight	10.65 kg (23.5 lb).
Height	138 mm (5.4 in).
Width	
With Handle	380 mm (15.0 in).
Without Handle	327 mm (12.9 in).
Depth	445 mm (17.5 in).
With Handle Extended	515 mm (20.3 in).

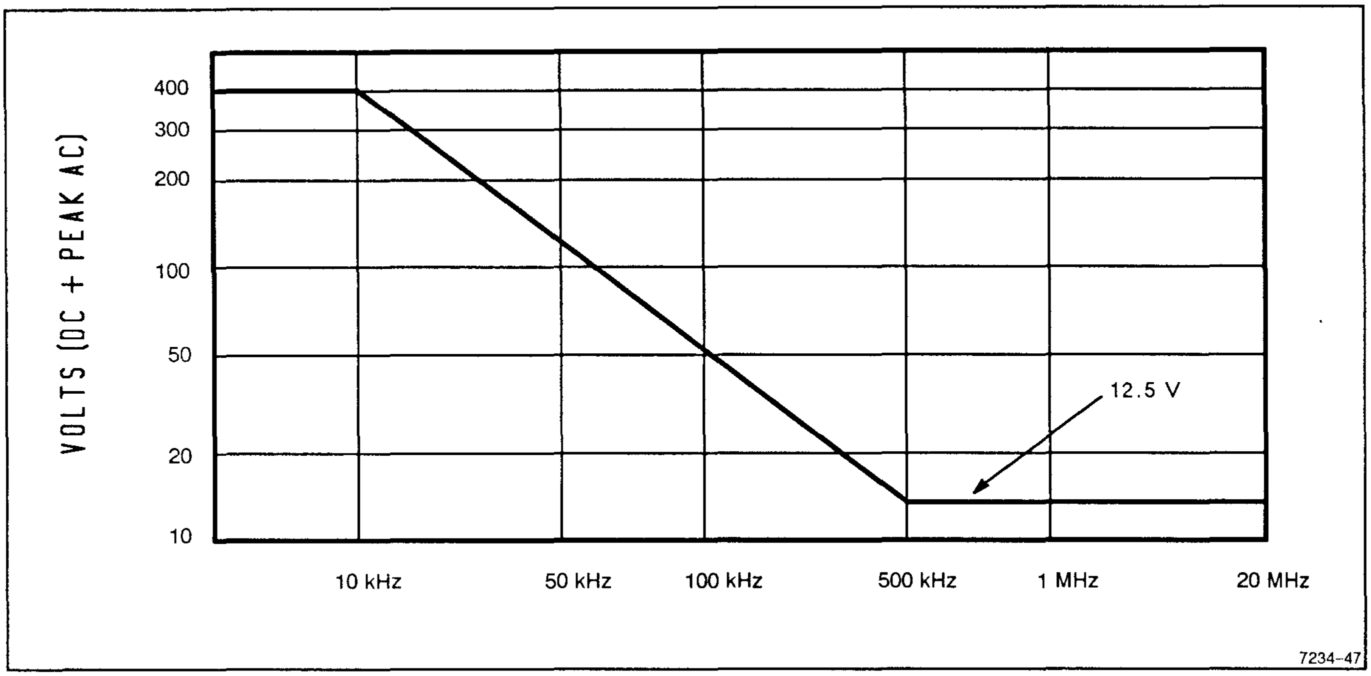


Figure 1-1. Maximum voltage versus frequency derating curve for the CH 1 OR X, CH 2 OR Y, and EXT INPUT OR Z connectors.

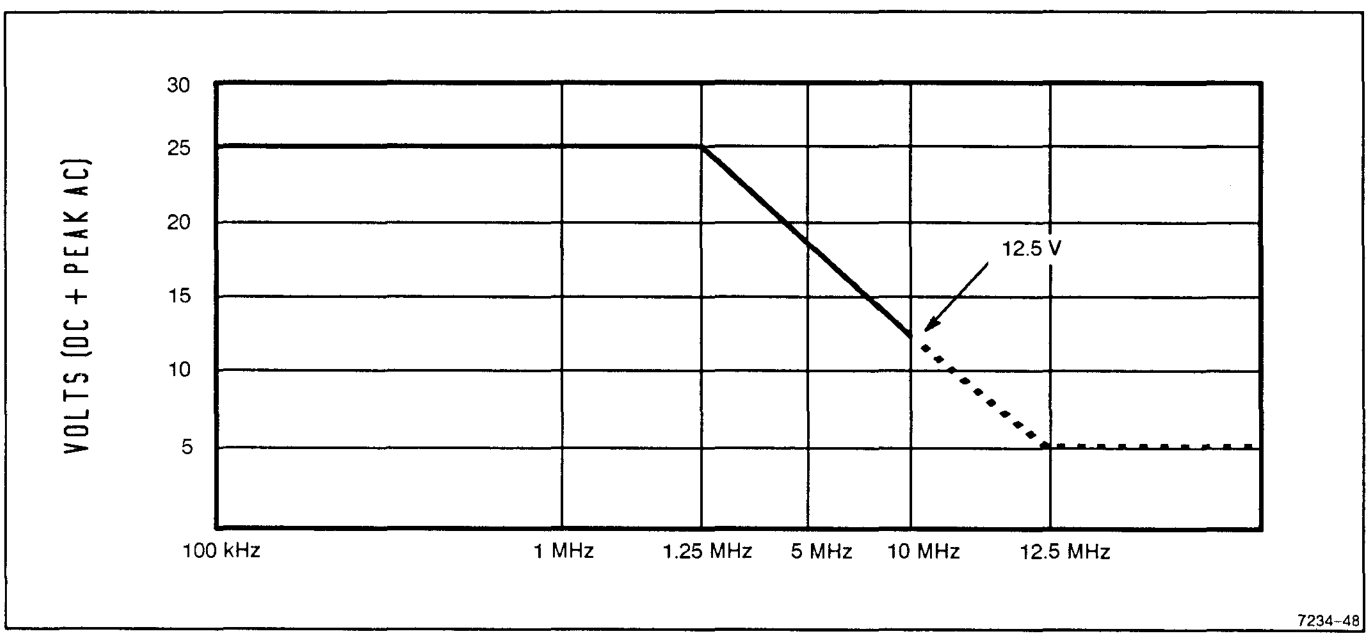


Figure 1-2. Maximum input voltage versus frequency derating curve for the EXT CLK connector.

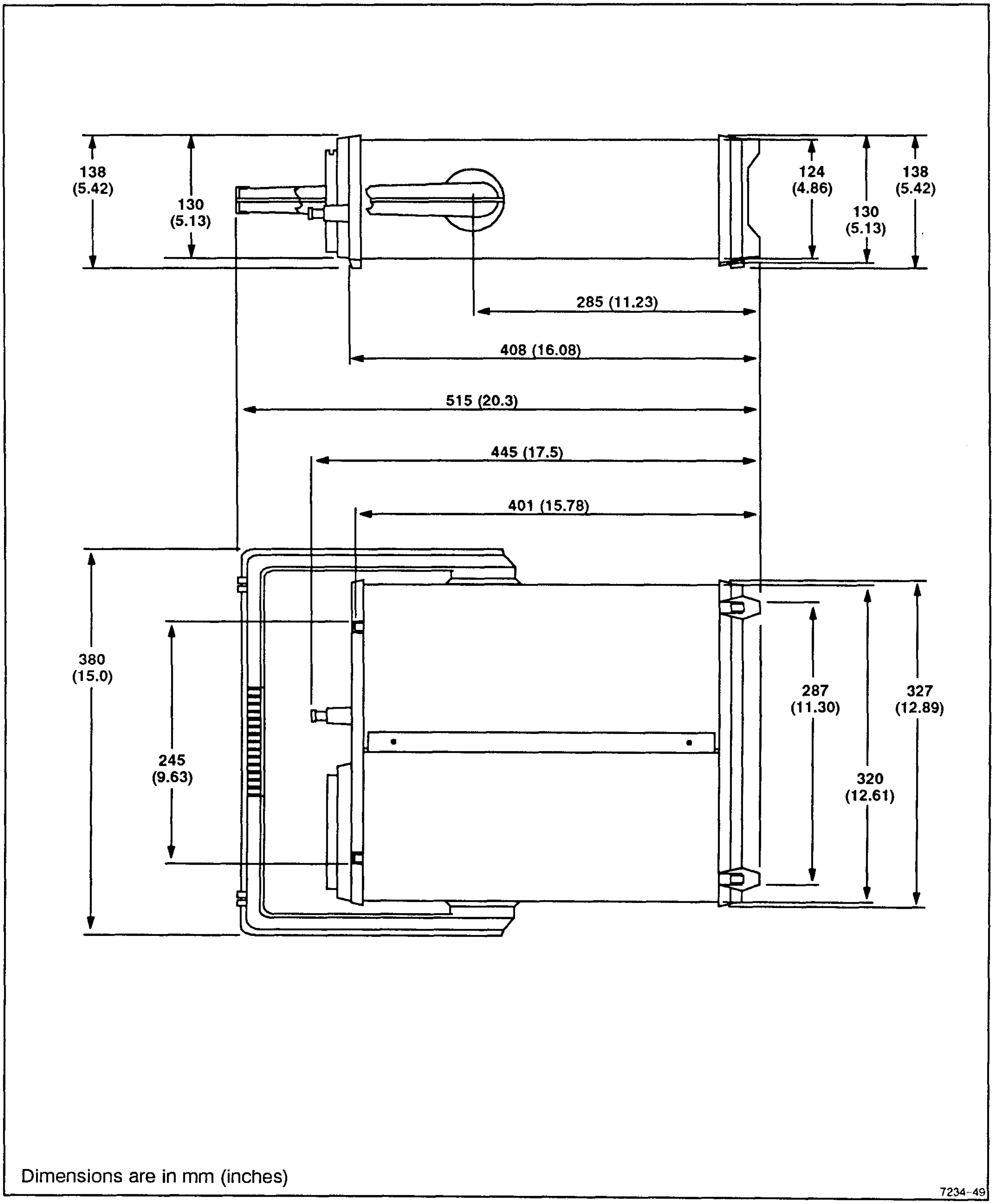


Figure 1-3. Instrument dimensional drawing.

OPERATING INSTRUCTIONS

PREPARATION FOR USE

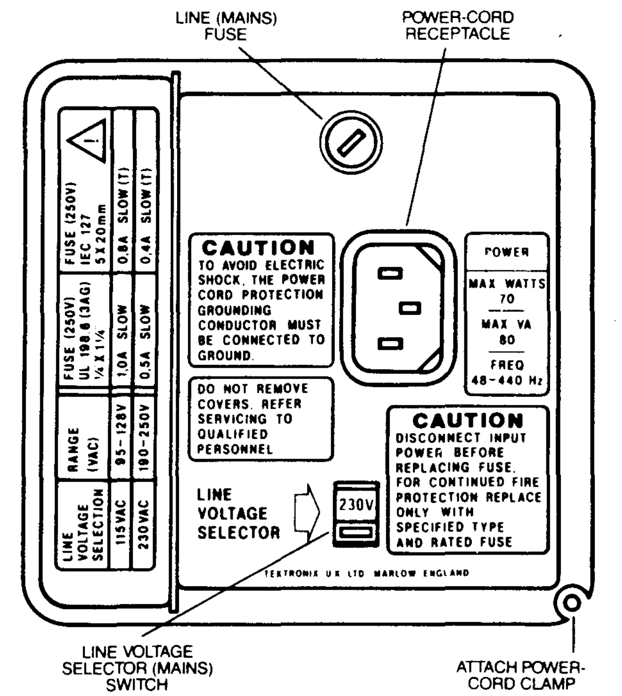
SAFETY

This section tells how to prepare for and to proceed with the initial start-up of the Tektronix 2211 Oscilloscope.

Refer to the Safety Summaries at the front of this manual for power source, grounding, and other safety considerations pertaining to the use of the instrument. Before connecting the oscilloscope to the power source, read both this section and the Safety Summaries at the beginning of this manual.

CAUTION

This instrument may be damaged if operated with the LINE VOLTAGE SELECTOR switch (on the rear panel) set for the wrong applied ac source voltage or if the wrong fuse is installed.



(6299-23)7234-50

Figure 2-1. Voltage Selector switch, fuse, and power-cord receptacle.

LINE VOLTAGE SELECTION

The oscilloscope operates from either a 115-V or a 230-V nominal ac-power line with any frequency from 48 Hz to 440 Hz. Before connecting the power cord to a power source, verify that the LINE VOLTAGE SELECTOR switch, located on the rear panel, is set correctly and that the proper line fuse is installed. Refer to Figure 2-1 and the instrument rear panel.

To convert the 2211 for operation on either line voltage range, set the LINE VOLTAGE SELECTOR switch to the required position and install the appropriate fuse (listed on the rear panel). The detachable power cord sent with the 2211 is the optional power cord ordered. If it does not match the power-source outlets in your locale, it should be replaced with an appropriate power cord. Part numbers for the optional power cords and matching fuses are listed in Options and Accessories (Section 7).

LINE FUSE

A fuse holder containing the instrument's line (mains) fuse is located on the rear panel. Use the following procedure to check that the proper fuse is installed or to install a replacement fuse.

1. Unplug the power cord from the power-input source (if plugged in).
2. Press in the fuse-holder cap and release it with a slight counterclockwise rotation.
3. Pull the cap (with the attached fuse inside) out of the fuse holder.
4. Verify that the installed fuse is the same type and rating as that listed on the back of the instrument.

NOTE

The UL198.6 and IEC 127 type fuses are not directly interchangeable; they each require a different type fuse cap.

5. Put the fuse (or replacement fuse) back in the fuse holder cap.

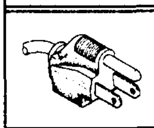
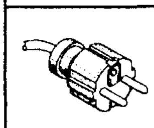
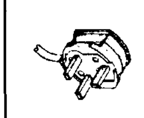
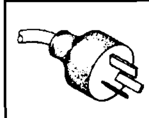
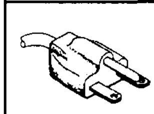
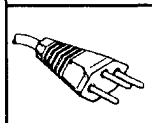
6. Reinstall the fuse and cap in the fuse holder by pressing in and giving a slight clockwise rotation of the cap.

POWER CORD

A detachable three-wire power cord with a three-contact plug is provided with each instrument for connecting to both the power source and protective ground. The protective-ground connector in the plug connects (through the protective-ground conductor) to the accessible metal parts of the instrument. For electrical-shock protection, insert this plug only into a power-source outlet that has a properly grounded protective-ground contact.

After plugging the power cord into its receptacle, secure it to the rear panel using the plastic clamp, screw, and washer provided.

Instruments are shipped with the power cord ordered by the customer. Available power-cord information is presented in Figure 2-2, and part numbers are listed in Options and Accessories (Section 7). Contact your Tektronix representative or local Tektronix Field Office for additional power-cord information.

Plug Configuration	Option	Power Cord/ Plug Type	Line Voltage	Reference Standards[b]
	U.S. Std.	U.S. 120V	120V	ANSI C73.11 NEMA 5-15-P IEC 83 UL 198.6
	A1	EURO 220V	220V	CEE(7), II, IV, VII IEC 83 IEC 127
	A2	UK[a] 240V	240V	BS 1363 IEC 83 IEC 127
	A3	Australian 240V	240V	AS C112 IEC 127
	A4	North American 240V	240V	ANSI C73.20 NEMA 6-15-P IEC 83 UL 198.6
	A5	Switzerland 220V	220V	SEV IEC 127

[a]A 6A, type C fuse is also installed inside the plug of the Option A2 power cord.

[b]Reference Standards Abbreviations:

ANSI—American National Standards Institute
AS—Standards Association of Australia
BS—British Standards Institution
CEE—International Commission on Rules for the Approval of Electrical Equipment
IEC—International Electrotechnical Commission
NEMA—National Electrical Manufacturer's Association
SEV—Schweizervischer Elektrotechnischer Verein
UL—Underwriters Laboratories Inc.

7234-51

Figure 2-2. Optional power cords.

INSTRUMENT COOLING

The 2211 is forced-air cooled to keep the internal components from overheating. Check that the fan-exhaust holes on the side panel and the air-intake holes on the sides and rear panel are not blocked before turning it on. After turning on the instrument, make sure that the fan is running.

INITIAL START-UP

Up to now, you should have made the following preparations:

1. Read the safety information.
2. Verified that the LINE VOLTAGE SELECTOR switch is set for the source voltage to be used.
3. Verified the fuse.
4. Attached the power cord.
5. Checked that there is adequate ventilation around the instrument.

6. Plugged the power cord into the appropriate power-source outlet.

Now turn on your oscilloscope by pressing in the POWER button. Observe that the POWER-ON indicator, located below the button, comes on.

REPACKAGING FOR SHIPMENT

If this instrument is shipped by commercial transportation, use the original packaging material. Unpack the instrument carefully from the shipping container to save the carton and packaging material for this purpose.

If the original packaging is unfit for use or is not available, repackage the instrument as follows:

1. Obtain a corrugated cardboard shipping carton having inside dimensions at least six inches greater than the instrument dimensions and having a carton test strength of at least 275 pounds.

2. If the instrument is being shipped to a Tektronix Service Center for repair or calibration, attach a tag to the instrument showing the following:owner of the instrument (with address), the name of a person at your firm who may be contacted if additional information is needed, complete instrument type and serial number, and a description of the service required.

3. Wrap the instrument with polyethylene sheeting or equivalent to protect the outside finish and prevent entry of packing materials into the instrument.

4. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the instrument, allowing for three inches of padding on each side (including top and bottom).

5. Seal the carton with shipping tape or with an industrial stapler.

6. Mark the address of the Tektronix Service Center and your return address on the carton in one or more prominent locations.

CONTROLS, CONNECTORS, AND INDICATORS

The following descriptions are intended to familiarize the operator with the location and function of the instrument's controls, connectors, and indicators.

POWER AND DISPLAY

See Figure 2-3 for location of items 1 through 8.

(1) **INTERNAL GRATICULE**—Eliminates parallax viewing errors between the trace and the graticule lines. Rise time amplitude and measurement points are indicated at the left edge of the graticule.

(2) **INTENSITY Control**—Adjusts the brightness of the NON-STORE trace display.

(3) **READOUT/STORE INTENSITY Control**—Adjusts the brightness of the STORE mode traces, CRT readout and cursor displays. This control is also used to either enable or disable the CRT readout and cursor display. The fully counterclockwise position of the control toggles the readout on and off.

(4) **BEAM FIND Switch**—Compresses the vertical and horizontal deflection to within the graticule area. The traces are intensified to aid the user in locating traces that are overscanned or deflected outside of the crt viewing area.

(5) **FOCUS Control**—Adjusts for optimum display definition. Once set, proper focusing is maintained over a wide range of display intensity.

(6) **TRACE ROTATION Control**—Permits alignment of the trace with the horizontal graticule lines. This control is a screwdriver adjustment that, once set, should require little attention during normal operation.

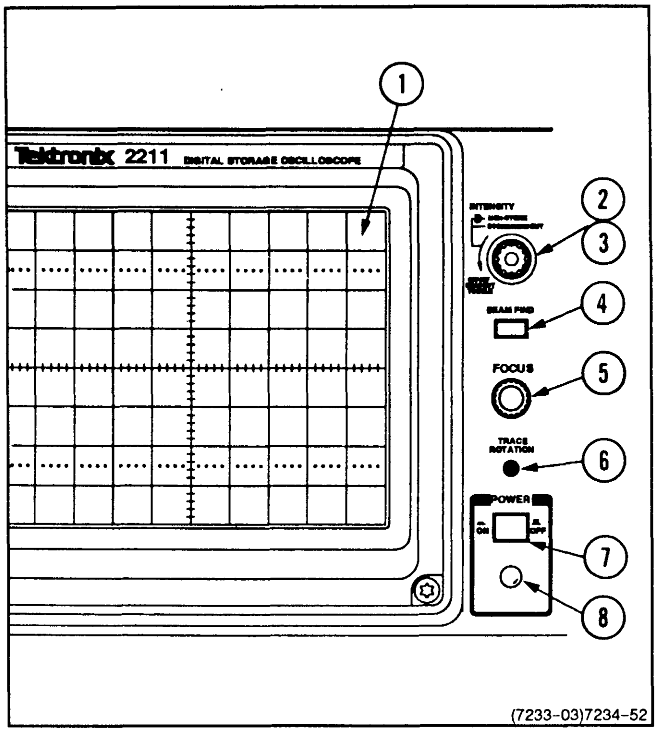


Figure 2-3. Power and Display controls and power-on indicator.

(7) **POWER Switch**—Turns instrument power on or off.

(8) **Power On Indicator**—Lights up while the instrument is operating.

VERTICAL

See Figure 2-4 for the location of items 9 through 17.

(9) **Channel 1 Vertical POSITION Control**—Controls the vertical display position of the Channel 1 signal. This control does not function in the NON-STORE, X-Y mode.

(10) **Channel 2 Vertical POSITION Control**—Controls the vertical display position of the Channel 2 signal. This control also positions the NON-STORE, X-Y mode display vertically.

(11) **CH 1-BOTH-CH 2 Vertical Mode Switch**—Selects the vertical channel(s) for display in both NON-STORE and STORE.

CH 1—Selects only the Channel 1 input signal for display.

BOTH—Selects a combination of Channel 1 and Channel 2 signals for display (CH 1-BOTH-CH 2 switch must be in the BOTH position for ADD, ALT and CHOP operation).

CH 2—Selects only the Channel 2 input signal for display.

(12) **NORM/CH 2 INVERT Switch**—Inverts the Channel 2 display when in the CH 2 INVERT position. With Channel 2 inverted, the oscilloscope may be operated as a differential amplifier when the BOTH-ADD Vertical Mode is selected. In NORM, the Channel 2 display and trigger signals are non-inverted. An invert symbol (↓) is displayed with the CH 2 VOLTS/DIV readout when CH 2 is inverted.

(13) **ADD-ALT-CHOP Vertical Mode Switch**—Selects the display mode for the two input signals when the CH 1-BOTH-CH 2 switch is set to BOTH.

ADD—Displays the sum of Channel 1 and Channel 2 input signals when BOTH is also selected. The difference of the Channel 1 and Channel 2 input signals is displayed when the Channel 2 signal is inverted. In STORE mode ADD, the sum of CH 1 and CH 2 is acquired by Channel 1.

ALT—Alternately displays the NON-STORE Channel 1 and Channel 2 input signals. Switching between channels occurs during retrace at the end of each sweep. ALT Vertical Mode is most useful for viewing both channel input signals at sweep rates of 0.5 ms per division or faster.

CHOP—Switches the display between Channel 1 and Channel 2 vertical input signals during the sweep. The chopped switching rate (CHOP frequency) is approximately 500 kHz.

In STORE mode both signals are acquired simultaneously. There is no functional difference between ALT and CHOP except when VERT MODE trigger is selected. When VERT MODE trigger is selected, each channel is acquired alternately.

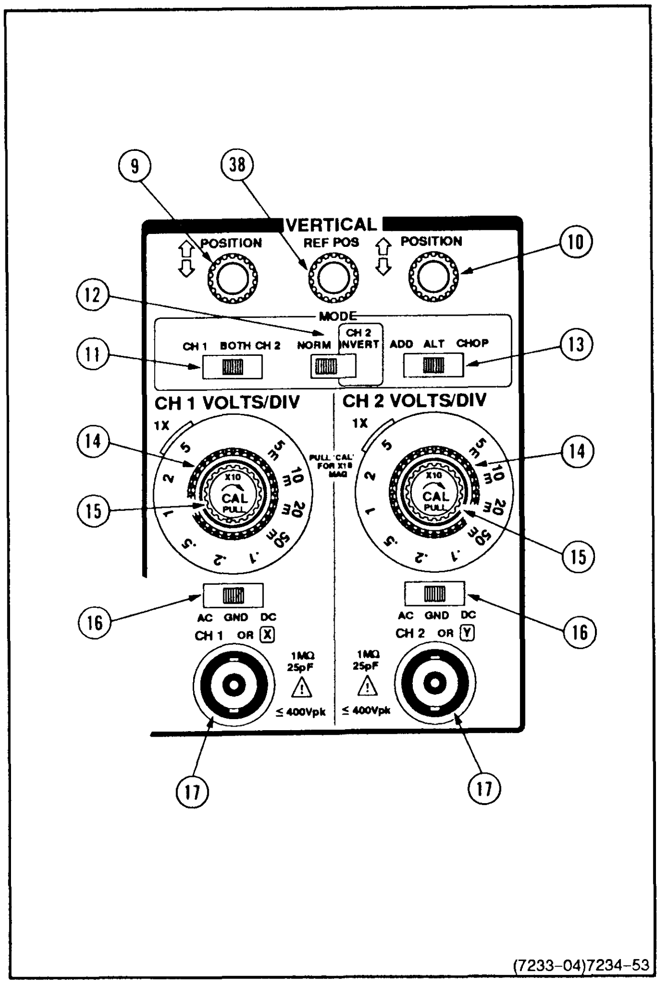


Figure 2-4. Vertical controls and connectors.

(14) **VOLTS/DIV Switches**—Select the vertical channel deflection factors from 5 mV to 5 V per division in a 1-2-5 sequence. The VOLTS/DIV switch setting for both channels is displayed in the crt readout.

1X PROBE—Front-panel marking that indicates the deflection factor set by the VOLTS/DIV switch when a 1X probe or a coaxial cable is attached to the channel input connector.

(15) **Variable VOLTS/DIV Controls**—Provide uncalibrated variable deflection factors between the calibrated settings of the VOLTS/DIV controls. The VOLTS/DIV sensitivity is reduced by at least 2.5 times at the fully counterclockwise rotation of the variable knob. The switch detent at full clockwise rotation is the CAL position of the variable knob. The uncalibrated condition is indicated by a greater-than symbol (>) in front of the affected VOLTS/DIV readout.

Pulling the Variable VOLTS/DIV control multiplies the vertical gain by X10 and limits the bandwidth. This latter condition is indicated in the readout display by the letters B_L.

(16) **AC-GND-DC (Input Coupling) Switches**—Select the method of coupling the input signal from the CH 1 and CH 2 vertical input connectors to the vertical amplifiers.

AC—Capacitively couples the input signal to the vertical amplifier. The dc component of the input signal is blocked. The lower -3 dB bandpass is 10 Hz or less. Selection of AC input coupling is indicated in the readout by a tilde symbol (~) in the associated channel's VOLTS/DIV readout.

GND—Grounds the input of the vertical amplifier, providing a zero (ground) reference voltage display. In GND, the input coupling capacitor charges to the average dc voltage level of the amplifier's input signal.

DC—All frequency components of the input signal are coupled to the vertical amplifiers.

(17) **CH 1 OR X and CH 2 OR Y Input Connectors**—Provide for application of the signals to the inputs of the vertical amplifiers.

In NON-STORE X-Y mode, the signal applied to the CH 1 OR X input connector controls the horizontal deflection, and the signal applied to the CH 2 OR Y input connector controls the vertical deflection.

HORIZONTAL

See Figure 2-5 for the location of items 18 through 23.

(18) **Horizontal POSITION Controls**—Position all the waveforms horizontally over a one-sweep-length range in X1, X10 or X50 Magnification. In STORE mode, with Δt cursors selected, operation of the Horizontal POSITION controls also moves the cursors as they are attached to the waveform(s).

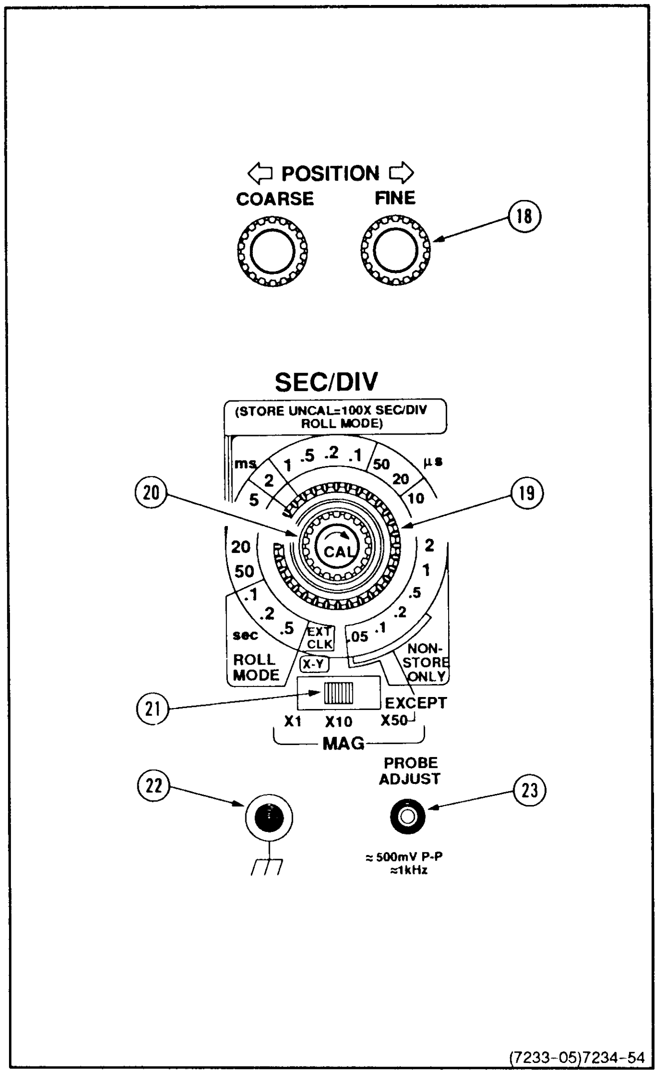


Figure 2-5. Horizontal controls.

(19) **SEC/DIV Switch**—Selects calibrated sweep rates from 0.5 s to 0.05 μs per division in a 1-2-5 sequence of 22 positions. The X-Y position selects the X-Y display in NON-STORE Mode. The CH 1 input signal provides horizontal deflection for X-Y displays, and the CH 2 input signal produces vertical deflection.

In STORE mode, the SEC/DIV switch determines the acquisition and display modes, sets the sampling rate, and establishes the time scale factor of the displayed waveforms. There are two storage modes with respect to the SEC/DIV switch setting (see Table 2-1).

Table 2-1
Storage Modes

SEC/DIV Switch Setting	SEC/DIV Variable	
	CAL	UNCAL
X-Y (EXTERNAL CLOCK)	RECORD Clock: dc to 10 MHz	ROLL Clock: dc to 4 kHz
0.05 μs to 10 μs	Error Indication [a]	Error Indication [a]
20 μs to 5 ms [b]	RECORD	RECORD
10 ms to 50 ms	RECORD	ROLL (100X) 1 s/div to 5 s/div
0.1 s to 0.5 s	ROLL (1X)	ROLL (100X) 10 s/div to 50 s/div

[a] Sec/Div? is displayed in the crt readout.
[b] The Variable SEC/DIV control has no effect in this range.

If a SEC/DIV range above 20 μs is selected while in STORE mode, the timebase readout displays Sec/Div?, indicating that an illegal control setting has been selected. The acquisition continues at the 20 μs/div rate.

RECORD Mode—Updates a full record of the acquired waveform each time a trigger event is recognized.

ROLL Mode—Continuously acquires and displays signals. The waveform display scrolls from right to left across the crt with the latest samples appearing at the right edge of the crt. Triggers are disabled except in SGL SWP.

At SEC/DIV settings of 10 ms and below, when the Variable SEC/DIV control is moved from the CAL position, the selected SEC/DIV setting is multiplied by 100 and the display mode is ROLL.

In STORE mode, X-Y on the SEC/DIV switch selects external clock. In this mode the acquisition rate is controlled by a signal applied to the EXTERNAL CLOCK connector located on the right hand side of the instrument.

The SEC/DIV switch setting is displayed in the crt readout.

(20) **Variable SEC/DIV**—Continuously varies the uncalibrated NON-STORE sweep time per division to at least 2.5 times the calibrated time per division set

by the SEC/DIV switch. Full counterclockwise rotation increases the slowest sweep time per division to at least 1 s. The uncalibrated condition is indicated by a greater than symbol (>) in front of the SEC/DIV readout.

In STORE mode (10 ms per division to 0.5 s per division), if the Variable control is switched out of CAL detent, the SEC/DIV switch setting is multiplied by 100 times (see Table 2-2). The control has no effect in STORE mode at SEC/DIV switch settings faster than 10 ms. When the SEC/DIV switch is set to EXT CLK, the Variable SEC/DIV control selects the display mode. In the CAL position, RECORD mode is selected, EXT CLK range DC to 10 MHz. Out of CAL detent, ROLL mode is selected, EXT CLK range DC to 4 kHz, and "ROLL" is displayed on the crt.

Table 2-2
Extended SEC/DIV Ranges

SEC/DIV Variable	
CAL	**UNCAL**
10 ms/div	1 s/div
20 ms/div	2 s/div
50 ms/div	5 s/div
0.1 s/div	10 s/div
0.2 s/div	20 s/div
0.5 s/div	50 s/div

(21) **Horizontal MAG Switch**—Selects the amount of horizontal magnification: X1, X10 or X50. Magnification occurs around the center vertical graticule division in both NON-STORE and STORE. The crt SEC/DIV readout will reflect the settings of both the SEC/DIV switch and the magnification factor. In STORE mode, with Δt cursors selected, operation of the Horizontal MAG switch will also magnify the cursors as they are attached to the waveform(s).

(22) **GND Connector**—Provides an auxiliary ground connection directly to the instrument chassis via a banana-tip jack.

(23) **PROBE ADJUST Connector**—Provides an approximately 0.5 V, negative-going, square-wave voltage (at approximately 1 kHz) for use in compensating voltage probes and checking the vertical deflection system. The PROBE ADJUST output is not intended as a reference in checking either the vertical or horizontal accuracy of the instrument.

TRIGGER

See Figure 2-6 for location of items 24 through 32.

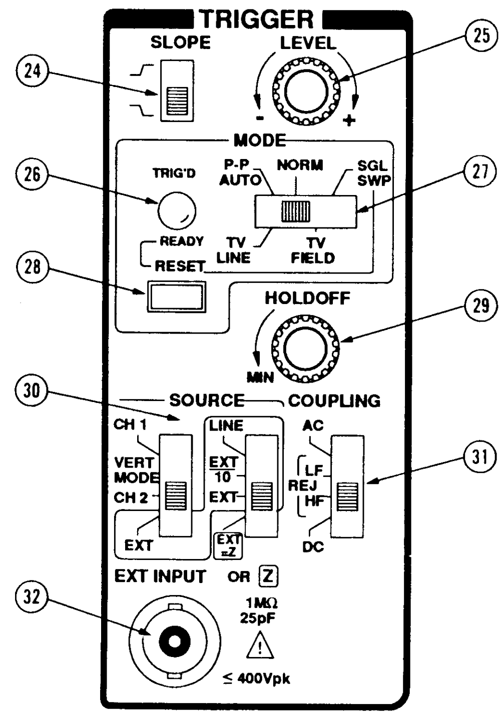


Figure 2-6. Trigger controls.

(24) **Trigger SLOPE Switch**—Selects either the positive or negative slope of the trigger signal to start the sweep.

(25) **Trigger LEVEL Control**—Selects the dc level that the Trigger signal must pass through to produce triggering. The Trigger point is displayed as a voltage

readout in the display field unless any of the following are selected:

Trigger Source CH 1 and CH 1 is AC coupled, or uncalibrated

Trigger Source CH 2 and CH 2 is AC coupled, or uncalibrated

Trigger Source VERT and Vertical Mode is CHOP

Trigger Source VERT and CH 1 is AC coupled or uncalibrated, or CH 2 is AC coupled or uncalibrated, or CH 1 VOLTS/DIV and MAG are not equal to CH 2 VOLTS/DIV and MAG

Trigger Source EXT

Trigger Coupling is not set to DC

Trigger Mode TV

(26) **TRIG'D/READY Indicator**—A dual-function, light-emitting diode (LED) indicator. In P-P AUTO, NORM, and TV FIELD Trigger modes, the indicator turns on when triggering occurs.

In NON-STORE, for SGL SWP Trigger mode the indicator turns on when the trigger circuit is armed awaiting a triggering event. The indicator turns off again as soon as the single sweep completes.

In STORE mode, selecting SGL SWP and pressing the RESET button starts the sampling to fill the pretrigger portion of the waveform RECORD. The TRIG'D/READY indicator does not come on until the pretrigger part of the RECORD is full. When the indicator comes on, the storage acquisition system is ready to accept a trigger event. Filling the remaining portion of the RECORD begins when that trigger occurs, and the indicator turns off when the RECORD is full. The time needed to fill the pretrigger and post-trigger portions of the RECORD depends on two things: the sampling rate, and the setting of the PRE-TRIG 25%/75% switch. Until a trigger occurs, the pretrigger data is continually updated, but the RECORD display is not updated until a complete new waveform is acquired.

(27) **MODE Switch**—Determines the NON-STORE sweep and STORE acquisition triggering mode. STORE mode triggering operation also depends on the position of the SEC/DIV switch.

P-P AUTO/TV LINE—In NON-STORE mode, the Trigger LEVEL control range is set to the peak-to-peak limits of the input trigger signal. Triggered operation occurs when the trigger signal has enough amplitude and occurs often enough (20 Hz and faster repetition rate) for the peak detectors to determine the signal peaks. If the trigger signal does not meet the requirements to produce a trigger event, an autotrigger is generated, and the sweep free runs.

In STORE mode, for SEC/DIV settings of 0.5 s per division to 0.1 s per division, the P-P AUTO Trigger Mode is disabled, and the input is continually digitized in the ROLL mode. ROLL mode is also enabled for SEC/DIV settings of 0.5 s to 10 ms if the Variable SEC/DIV control is switched out of the CAL detent (100X SEC/DIV settings). In RECORD mode, at SEC/DIV settings from 50 ms to the maximum STORE mode setting of 20 μs, triggering occurs under the same conditions as for NON-STORE, P-P AUTO Trigger Mode.

NORM—Permits triggering at all NON-STORE sweep speeds. The Trigger LEVEL control must be set correctly to produce a sweep; an autotrigger is not generated if there is no trigger signal. NORM Trigger Mode is especially useful in obtaining a stable display of low-frequency and low-repetition-rate signals.

In STORE mode RECORD, the display is updated once the acquisition is complete; the last waveform acquired remains displayed until that time.

In ROLL, the trigger signal is ignored for all the Trigger modes except in SGL SWP Trigger mode (see Table 2-3). In non-triggered ROLL mode, the display is continually updated at the digitization rate.

Table 2-3
ROLL Trigger Modes

TRIGGER MODE	ROLL MODE Trigger Operation
P-P AUTO	Untriggered ROLL
NORM	Untriggered ROLL
TV TRIG (LINE and FIELD)	Untriggered ROLL
SGL SWP	Triggered ROLL

TV FIELD—Permits stable triggering on a television field (vertical sync) signal. In the absence of an adequate trigger signal, the sweep (or acquisition) free runs. The instrument otherwise behaves as in P-P AUTO. When TV FIELD is selected, "TV" is displayed in the crt readout.

SGL SWP—Selects single sweep operation.

NOTE

To avoid the possibility of losing parts of the sweep, it is advisable to switch the readout system off when doing single sweep measurements at SEC/DIV settings of greater than 0.2 ms in NON-STORE mode.

In RECORD mode, upon entering SGL SWP the last waveform acquired remains displayed. Pressing the RESET button rearms the trigger circuitry to accept the next triggering event. When a trigger event is recognized, the full record is acquired and the display updates. If BOTH-ALT Vertical Mode is selected along with VERT MODE Trigger SOURCE, the triggered channel behaves as just described. The non-triggered channel display is not updated. Pressing the RESET button again causes the second channel to update.

If the display mode is ROLL when SGL SWP is selected, the display continues to roll because the trigger circuit is not armed. When the RESET button is pushed to arm the trigger circuit, the display continues rolling until the pretrigger portion of the RECORD is full. The trigger point indicator (intensified dot) then appears on the waveform, and the TRIG'D/READY indicator lights. The display continues to roll as data is acquired to fill the post-trigger portion of the RECORD. The amount of pretrigger information in a RECORD is set by the 25%/75% PRETRIG button. In SGL SWP, if BOTH-ALT Vertical mode is selected along with VERT MODE Trigger Source, the triggered channel behaves just as described; the non-triggered channel is blanked. The triggered and non-triggered channel alternates with each press of the RESET button.

(28) **RESET**—Arms the trigger circuit either for a single sweep in NON-STORE SGL SWP or a single acquisition in STORE SGL SWP. Triggering requirements are the same as in NORM Trigger Mode. After the completion of a triggered NON-STORE sweep or a STORE SGL SWP acquisition, pressing in the RESET button rearms the trigger circuitry. In NON-STORE mode, the next trigger event can then be accepted to start the sweep. For STORE mode, the pretrigger acquisition is started when the RESET button is pressed.

(29) **Variable HOLDOFF Control**—Adjusts the NON-STORE variable holdoff time. NON-STORE variable holdoff starts at the end of the sweep. STORE mode holdoff starts at the end of the acquisition cycle; it ends when the waveform data has been transferred from the acquisition memory to the display memory and the pretrigger portion of the RECORD has been filled. After STORE mode holdoff ends, the next acquisition can be triggered after the next (or current, if one is in progress) NON-STORE holdoff ends. STORE mode holdoff can be much longer than the sweep time so that several NON-STORE holdoff periods may have occurred during STORE holdoff time. This ensures that STORE mode triggering is controllable by the Variable HOLDOFF control and will be stable if the NON-STORE display is stable.

(30) **Trigger SOURCE Switches**—Determines the source of the internal and external trigger signal for the trigger generator circuits.

CH 1—Trigger signal is obtained from the channel 1 input and "CH 1" is displayed in the crt readout.

VERT MODE—Trigger signals are obtained alternately from the CH 1 and CH 2 input signals in ALT Vertical Mode. In CHOP Vertical Mode, the trigger signal source is the sum of the CH 1 and CH 2 input signal. When VERT MODE is selected, "VERT" is displayed in the crt readout.

CH 2—Trigger signal is obtained from the channel 2 input and "CH 2" is displayed in the crt readout. The NORM/CH 2 INVERT switch also inverts the polarity of the internal CH 2 trigger signal when the CH 2 display is inverted.

EXT—Selects external triggers. The actual form these triggers take is selected by the second SOURCE switch. When EXT is selected, "EXT" is displayed in the crt readout.

LINE—Routes a sample of the ac power line signal to the trigger circuit.

EXT/10—Attenuates the external signal applied to the EXT INPUT OR Z connector by a factor of 10 before applying it to the trigger circuit.

EXT—Routes an external signal applied to the EXT INPUT OR Z connector to the trigger circuit.

EXT=Z—Routes the signal from the EXT INPUT OR Z connector to the Z-axis amplifier rather than the trigger circuit. If EXT and EXT=Z are both selected, the signal applied to the EXT INPUT OR Z connector is routed to both the trigger circuit and the Z-axis amplifier.

(31) **COUPLING Switch**—Determines the method of coupling for the signal applied to the trigger circuit.

AC—Input signal is capacitively coupled, and the dc component (below 10 Hz) from the trigger circuit is blocked. "AC" is displayed in the crt readout.

HF REJECT—Rejects (attenuates) the high-frequency components (above 30 kHz) from the trigger circuit. "HF rej" is displayed in the crt readout.

LF REJECT—Rejects (attenuates) the low-frequency components (below 30 kHz) from the trigger circuit. "LF rej" is displayed in the crt readout.

DC—Couples all frequency components of the external signal to the trigger circuit (DC to full bandwidth).

(32) **EXT INPUT OR Z Connector**—Provides for connection of external signals to the trigger circuit or, if EXT=Z is selected, to the Z-axis amplifier.

STORAGE CONTROLS

See Figure 2-7 for locations of items 33 through 37, and Figure 2-4 for location of item 38.

(33) **STORE/NON-STORE Switch**—Selects either the NON-STORE or the STORE waveforms for display. The STORE acquisition system is turned off while NON-STORE is selected so that the last waveform acquired in STORE mode remains in memory. NON-STORE is selected when the button is out; STORE mode when pressed in.

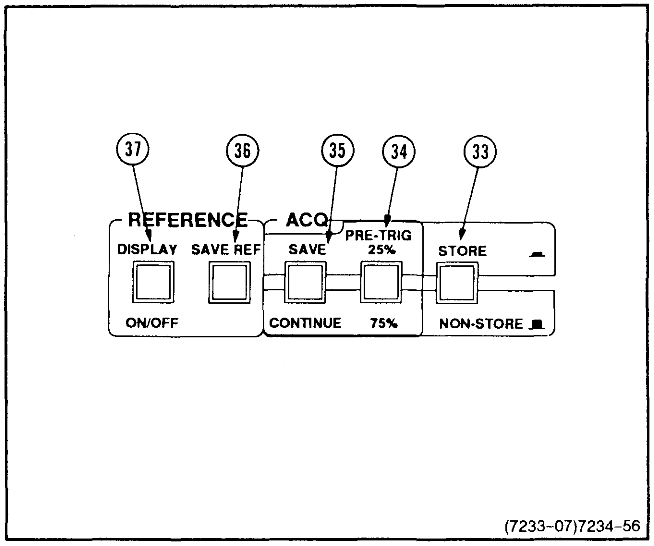


Figure 2-7. Storage controls.

(34) **PRE-TRIG 25%/75% Switch**—Selects either 25% or 75% pretrigger. If either RECORD mode or SGL SWP ROLL mode is selected, the trigger position is shown on the display by an intensified dot. Selects 75% pretrigger when out; 25% when pressed in.

(35) **ACQ SAVE/CONTINUE Switch**—Stops the display from being updated when pressed in. If the display mode is ROLL, the current acquisition is stopped immediately upon pressing the button. Releasing the button causes the acquisition to continue. If the display mode is RECORD, the current display is held immediately upon pressing the button. When the button is released, the display is updated with the acquisition that was in progress when the SAVE button was pushed. On returning to the CONTINUE mode, previously acquired waveforms are no longer valid if the control settings were changed while in SAVE mode. The next waveform acquired in CONTINUE mode will reflect any changes made. When SAVE is selected, "SAVE" appears at the bottom of the readout display.

(36) **Reference SAVE REF Switch**—Saves the displayed STORE mode waveform(s) into the reference memory.

NOTE

Only the on-screen portions of the STORE waveform will be correctly saved in the Reference memory.

The saved Reference waveform is displayed on the crt. When the SAVE REF button is pressed, previously saved waveform(s) are over-written by the displayed acquisition waveform(s). The Reference waveform(s) remain in memory when the instrument is switched between STORE and NON-STORE modes. Reference waveforms are NOT saved when the oscilloscope is turned off.

(37) **Reference DISPLAY ON/OFF Switch**—Turns the stored reference waveform display on and off when in STORE mode.

(38) **Reference POSITION Control**—Allows vertical positioning of the saved Reference waveforms. The Reference waveforms may only be positioned in the positive region from the level at which they were saved; they cannot be positioned below that level.

NOTE

Any portions of the STORE waveform that are out of the display area will not be saved correctly in the Reference memory when SAVE REF is pressed. The off-screen portion will be clipped. The clipping effect is seen when saving a waveform that is partially off the bottom of the crt display. When the Reference waveform is positioned upward to bring it on-screen, the bottom of the display will be clipped. The effect cannot be seen on the Reference waveforms clipped at the top because they cannot be positioned downwards.

CURSOR

See Figure 2-8 for the location of items 39 through 43.

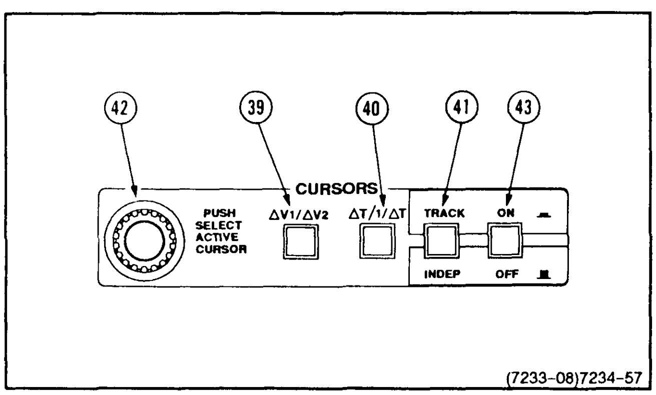


Figure 2-8. Cursor controls.

(39) **DELTA V Switch**—Activates the Delta Volts (ΔV) measurement function and cancels any other Delta measurement function when momentarily pressed. The CRT readout displays the equivalent voltage represented by the separation between the two cursors with VOLTS/DIV scaling defined by the setting of the selected vertical channel's VOLTS/DIV switch. The selection of the VOLTS/DIV switch is defined by the operation of the ΔV switch such that, when the ΔV function is inactive, depressing the ΔV switch selects the VOLTS/DIV switch previously selected for ΔV measurement mode (CH 1 is selected after switch-on), and, when the ΔV function is active and Vertical MODE is set to BOTH, subsequent depressions of the ΔV button will toggle VOLTS/DIV scaling between CH 1 and CH 2 VOLTS/DIV switches. If CH 1 is not displayed, ΔV1 will not be enabled. Likewise, if CH 2 is not displayed, ΔV2 will not be enabled. Each channel has its own independent cursors and channel selection is indicated in the Readout field. The position of the cursors on the display are set by the Cursor Position control. The DELTA Volts readout is displayed as a percentage ratio (with five divisions corresponding to a 100% ratio) if either one of the following conditions exist:

(1) The selected vertical channel is uncalibrated (VOLTS/DIV CAL control out of detent), or

(2) ADD is selected when the CH 1 and CH 2 deflection factors are not the same (VOLTS/DIV switches are at different settings or at least one is uncalibrated). The setting of the VOLTS/DIV switch must take account of the X10 PULL function.

When the 2211 is in NON-STORE X-Y Mode, the Delta VX and Delta VY cursors can be enabled via the Delta V switch. The ΔV1 cursors become the ΔVX cursors and the ΔV2 cursors become the ΔVY cursors, and pressing the Delta V switch toggles between them. The ΔVX cursors present a voltage measurement dependent upon the difference between the position of the cursors and the CH 1 VOLTS/DIV setting. Likewise, the ΔVY cursors present a voltage measurement dependent upon the difference between the position of the cursors and the CH 2 VOLTS/DIV setting. The ΔVX cursors are similar in appearance to the time cursors, i.e., vertical lines on the crt, whereas the ΔVY cursors are similar in appearance to the voltage (ΔV1, ΔV2) cursors. If the channel VOLTS/DIV switches are in UNCAL, ΔVX and ΔVY measurements will be displayed as ratios with 5 screen divisions equal to 100%.

(40) **DELTA t 1/DELTA t Switch**—Activates the Delta Time (Δt) measurement function and cancels any other Delta measurement functions when momentarily pressed in. When the Δt function is active, momentarily pressing in the Δt button selects the 1/Delta t ($1/\Delta t$) function. Subsequent operation of this button toggles between the Δt and $1/\Delta t$ functions. The CRT Readout displays the time difference (Δt), or it's reciprocal ($1/\Delta t$), between the two vertical cursors with SEC/DIV scaling defined by the positions of the SEC/DIV and MAG switches. When the SEC/DIV switch selects the EXT CLK function, the Δt function displays the difference between the two cursors in graticule divisions, and the $1/\Delta t$ function displays it's reciprocal. The positions of the cursors on the display are set by the Cursor Position control. In NON-STORE, if the SEC/DIV CAL control is not in the detent position, Δt cursor difference is expressed as a ratio with five divisions corresponding to a 100% ratio, and $1/\Delta t$ as phase with five divisions corresponding to 360°. In STORE, if the SEC/DIV CAL control is not in the detent position, the SEC/DIV switch setting is multiplied by 100 times, except at SEC/DIV switch settings faster than 10 ms, when the SEC/DIV CAL control has no effect.

In STORE mode, Δt cursors are attached to the waveform(s) (waveform-based cursors). Once on the required measurement points, operation of both the Horizontal POSITION control and/or the Horizontal MAG switch will result in the cursors moving with the waveform rather than independently of it.

(41) **TRACK/INDEP Switch**—Selects either the tracking or independent mode for the Cursor Position control. When in the TRACK mode, the difference between cursors does not change with rotation of the Cursor Position control. When the Cursor Position control is rotated, both cursors move equally until the limit of either is reached. If INDEP is selected, the cursors are independently movable using the Cursor Position control.

(42) **Cursor Position Control**—Positions the Delta time cursors (vertical line) when either the Δt or $1/\Delta t$ Measurement Mode is active. When the ΔV Measurement Mode is active, the control positions the Delta Voltage cursors (horizontal line). Rotating the control clockwise moves the ΔV cursors upwards or the Δt cursors to the right. Pushing the Cursor Position control will toggle the selection of the active cursor.

(43) **ON/OFF Control**—When Cursor Measurement mode is active, depressing this button cancels the cursor measurement mode, extinguishing the cursors and the cursor measurement display. When the Cursor Measurement mode is inactive, depressing this button enables the cursor measurement mode, enabling the cursors and the cursor measurement display. When the instrument is first switched on, the Readout display will indicate the current switch settings, and $\Delta V1$ will be operative: if CH 1 or BOTH is selected, or, if CH 2 is selected, $\Delta V2$ will be operative.

NOTE

The cursors and cursor Delta readout are disabled in the following mode: STORE, ROLL, Delta t cursors, X50 Horizontal MAG and NON-SAVE.

REAR PANEL

See Figure 2-9 for the location of items 44 through 46.

(44) **Fuse Holder**—Contains the ac-power-source fuse. See the rear panel nomenclature for fuse rating and line voltage range.

(45) **Detachable Power Cord Receptacle**—Provides the connection point for the ac power source to the instrument.

(46) **Line Voltage Selector (Mains switch)**—Selects the line voltage range either 115 V or 230 V.

SIDE PANEL

Refer to Figure 2-10 for the location of items 47 through 50.

(47) EXT CLOCK—Provides a TTL compatible input for external clock signals to the storage acquisition circuit. The EXT CLOCK input signal is selected when the SEC/DIV switch is in the EXT CLK position. The maximum input frequency permitted depends on the display mode (RECORD or ROLL). The mode is selected with the Variable SEC/DIV control. The frequency ranges are dc to 10 MHz in RECORD mode (Variable SEC/DIV control in CAL detent) and dc to 4 kHz in ROLL mode (Variable SEC/DIV control out of the CAL detent position).

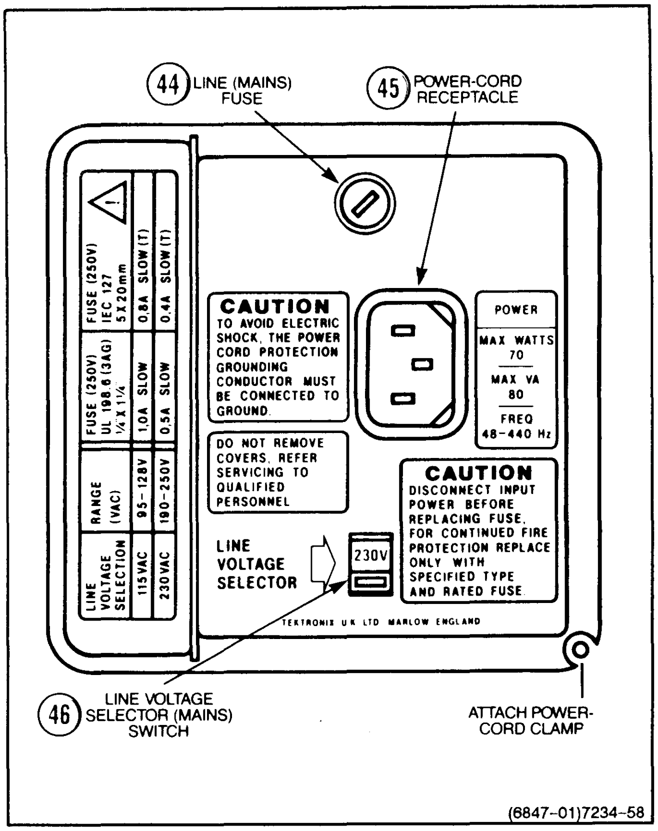


Figure 2-9. Rear panel.

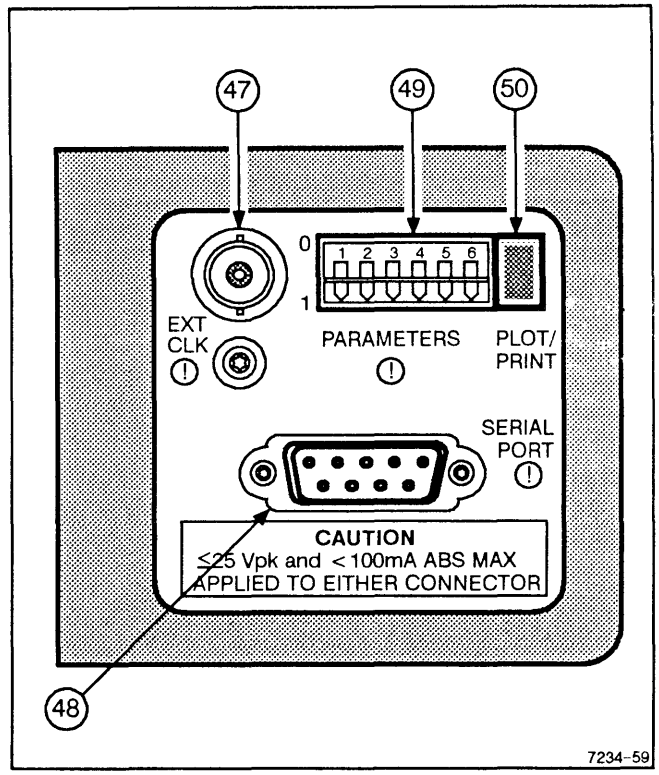


Figure 2-10. Right side panel.

(48) SERIAL INTERFACE CONNECTOR—Provides the interface signals which are assigned to the connector as shown in Table 2-4.

(49) PARAMETER SWITCHES—Select the options of the interface. Switch settings are given in Figure 2-11.

Table 2-4
Serial Interface Connector

Signal Name	Abbreviation	Pin Number	Direction[1]
–	–	1	–
Receive Data	Rx	2	In
Transmit Data	Tx	3	Out
Data Terminal Ready	DTR	4	Out
Ground	GND	5	–
Data Set Ready	DSR	6	In
Request To Send	RTS	7	Out
Clear To Send	CTS	8	In
Plot Button	PB	9	In

[1]Signal directions are as viewed from the serial interface.

S1	S2	S3	S4	S5	S6

Handshaking	Brown
Hardware (RTS, CTS, DSR, DTR)	0
Software (XON, XOFF)	1

Graticule on/off	Red
OFF (Screen Boundary only)	0
ON	1

Baud Rate	Orange	Yellow
9600	0	0
4800	0	1
1200	1	0
300	1	1

Printer/Plotter Format Select	Green	Blue
EPS1 - Epson Printers, 1 plot per page	0	0
EPS2 - Epson Printers, 2 plots per page	0	1
HPGL1 - HP-GL Plotters, 1 pen	1	0
HPGL4 - HP-GL Plotters, 4 pens	1	1

Where 0 = Dip-Switch in UP Position
1 = Dip-Switch in DOWN Position

HPGL is a trademark of Hewlett-Packard Company.
Epson is a trademark of Epson Corporation.

7234-80

Figure 2-11. Switch Selections.

Handshaking (Switch 1)

Both hardware (RTS/CTS and DTR/DSR) and software (XON/XOFF) handshaking are directly supported and selected via S1.

Hardware handshaking utilizes both the RTS/CTS and DTR/DSR signals as follows:

- DTR is asserted when the 2211 Serial Interface is ready and on-line.
- RTS is asserted when print/plot data is ready to transmit.
- Data is transmitted when both CTS and DSR are asserted.

Software handshaking makes use of the XON and XOFF flow control characters which are sent across the data channel. This allows for three-wire (Tx, Rx, and Ground) communications to be established.

Graticule On/Off (Switch 2)

This switch is used to enable/disable the printing/plotting of the screen graticule. If disabled, only the graticule border is plotted.

Baud Rate (Switches 3 and 4)

Switches 3 and 4 select the transmit and receive baud rate.

Printer/Plotter Format (Switches 5 and 6)

These switches select the printer/plotter digital data format. A summary of the data formats is given as follows:

Epson Printer (or compatible) Formats

The format for Epson™[1] printers uses 7 bit data and utilizes the ESC-L graphics mode.

HP-GL (Hewlett-Packard Graphics Language) Plotter formats

Both the HP-GL™[1] drivers (HPGL1 and HPGL4) use a small subset of the HP-GL command-set. The commands used are summarized as below:

Command arguments are shown in < > braces.

Scale	SC <scale x, scale y>;
Select Pen	SP <pen number>;
Move with Pen Up	PU;
Move with Pen Down	PD;
Set Defaults	DF;
Move Absolute	PA <absolute x,y location>;
Set Character Size	SR <character width, character height>;
Plot Text String	LB <text string> <ETX character>;

The fixed pen allocations for the HPGL4 mode are:

Graticule, Readout and Cursors	Pen 1
Acquisition channel 1 Data	Pen 2
Acquisition channel 2 Data	Pen 3
Reference channel 1 Data	Pen 4
Reference channel 2 Data	Pen 1

The x,y command arguments for the PA command are restricted to the scale x and scale y limits defined in the scale command.

[1] **HP-GL is a registered trademark of Hewlett-Packard Company. Epson is a registered trademark of Epson Corporation.**

(50) PRINT/PLOT SWITCH—Is used to initiate and terminate waveform dumps to printers and plotters. A print/plot of the displayed waveform data can be initiated in either of two ways as follows:

- By operating the print/plot push button.
- By shorting pin 9 (PB) and pin 5 (GROUND) of the DTE connector.

The latter operation allows for printing/plotting to be remotely initiated and is of particular use in rack-mounted versions

A print/plot can be aborted in two ways:

- By operating the print/plot push button for more than 5 seconds when a plot is in progress.
- By shorting pins 9 and 5 of the DTE connector for more than 5 seconds when a plot is in progress.

NOTE

Neither the Horizontal POSITION control nor the Horizontal Magnification switch has any effect on the horizontal position of a plot. The hardcopy output represents the unmagnified (X1 Horizontal MAG) screen and the plotted SEC/DIV scaling reflects the unmagnified horizontal deflection factor.

CRT READOUT

See Figure 2-12 for an indication of the crt readout displays.

The Readout system provides an alphanumeric display of information on the crt along with the waveform displays. The readout is displayed in two rows of characters. One row is within the top graticule division, the other within the bottom graticule division.

Cursor Type—Indicates which Δ function has been selected. Possible values are: ΔV1, ΔV2, ΔT, 1/ΔT, Ratio, Phase, ΔVX, and ΔVY.

Cursor Delta Value—Indicates the difference between the two cursors. Units will depend upon the cursor type.

Trig—Indicates that the following information relates to the Trigger point. This field is used for information only.

Trigger Value—Indicates the value of the Trigger Level. This field is disabled in X-Y mode and a number of other trigger modes as described on page 2-8 of this section.

Trigger Source—Indicates the current Trigger Source. Possible values are: CH 1, CH 2, VERT and EXT.

CH 1 Vertical Deflection—Indicates the current CH 1 VOLTS/DIV switch setting. A > sign appears before the value if the switch is in the UNCAL position, a ~ sign appears after the value if the input is AC coupled, and B_L appears if the channel bandwidth is limited.

ADD—If the instrument is set for ADD Mode, a + sign appears in this field, otherwise the field is blank.

CH 2 Vertical Deflection—Indicates the current CH 2 VOLTS/DIV switch setting. A > sign appears before the value if the switch is in the UNCAL position, a ~ sign appears after the value if the input is AC coupled, B_L appears if the CH 2 bandwidth is limited, and a down arrow (↓) is displayed if CH 2 is inverted.

Horizontal Deflection—Indicates the current value of the SEC/DIV switch. A > sign appears before the value if the switch is in the UNCAL position.

Acquisition Status—Indicates whether the instrument is in SAVE or ROLL mode. This field is only active in STORE mode.

The ΔT, 1/ΔT, ΔVX, and associated Phase and Ratio cursors are displayed as vertical lines on the crt. The ΔV_1, ΔV_2, ΔVY, and associated Ratio cursors are displayed as horizontal lines on the crt as shown in Figure 2-12.

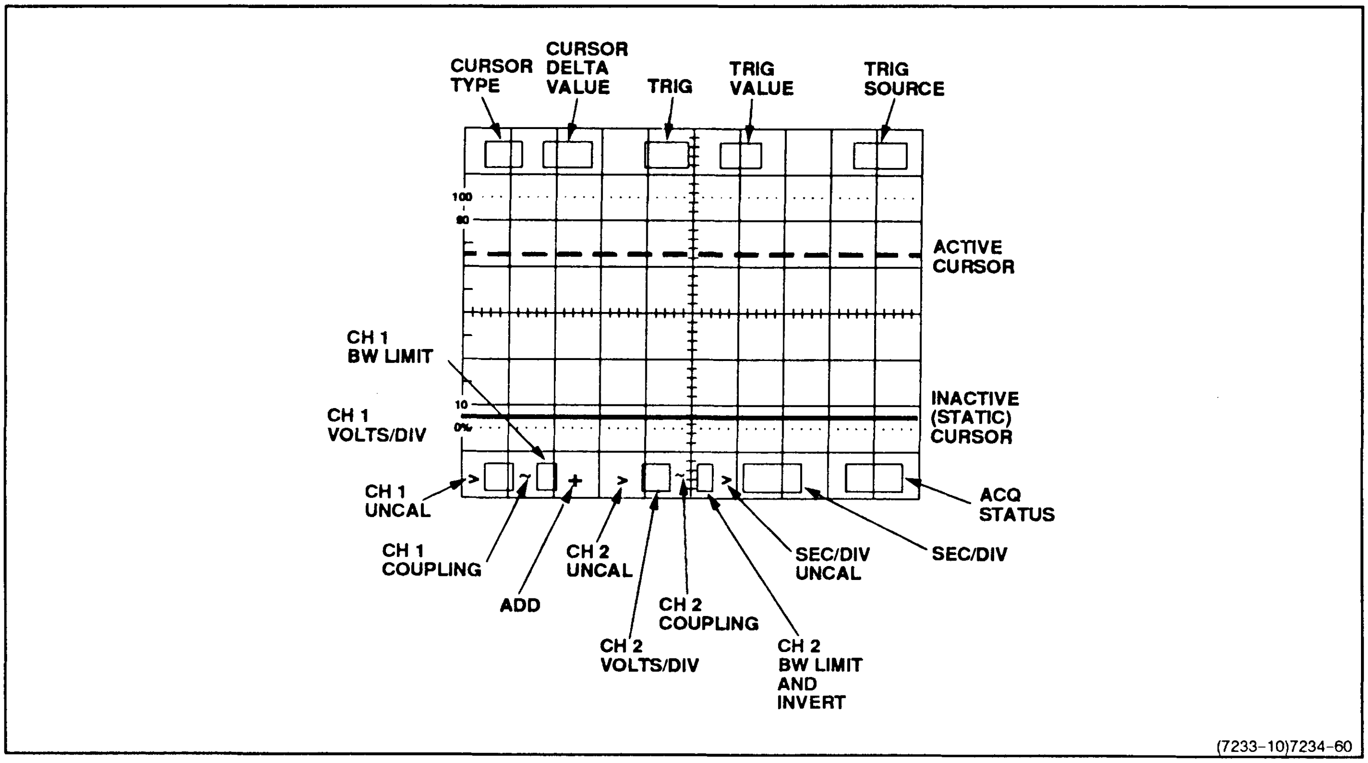


Figure 2-12. CRT Readout display.

OPERATING CONSIDERATIONS

This section contains basic operating information and techniques that should be considered before attempting to make any measurements with the instrument.

GRATICULE

The graticule is internally marked on the faceplate of the crt to eliminate parallax-viewing errors and to enable measurements (see Figure 2-13).

The graticule is marked with eight vertical and ten horizontal major divisions. Each major division is further divided into five subdivisions. The vertical deflection factors and horizontal timing are calibrated to the graticule for making accurate measurements directly from the crt. Percentage marks to assist the user in making rise and fall time measurements are located on the left side of the graticule.

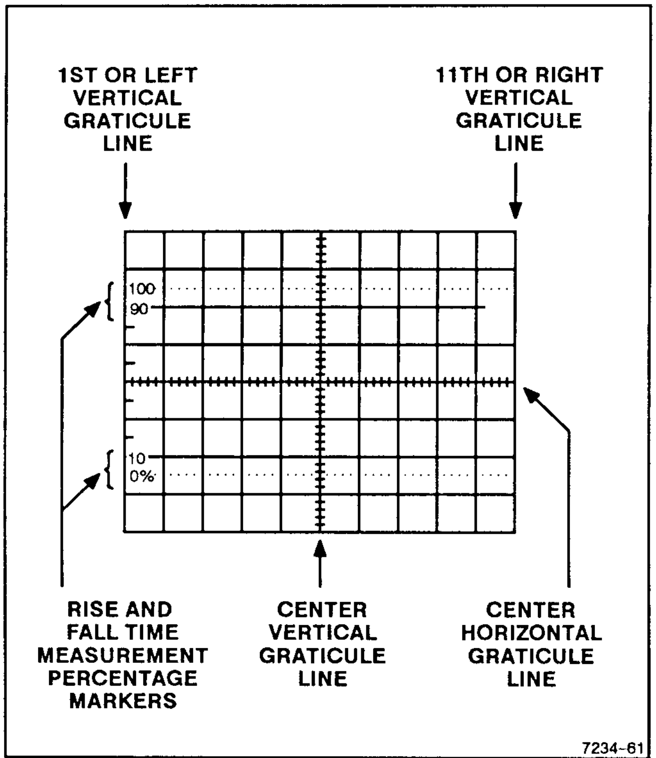


Figure 2-13. Graticule measurement markings.

GROUNDING

The most reliable signal measurements are made when the 2211 and the unit under test are connected by a common reference (ground lead) in addition to the signal lead or probe. The probe's ground lead provides the best grounding method for signal interconnection and provides the maximum amount of signal-lead shielding in the probe cable. A separate ground lead can also be connected from the unit under test to the oscilloscope ground receptacle located on the oscilloscope's front panel.

SIGNAL CONNECTIONS

Probes

Generally, the accessory probes that come with the instrument provide the most convenient way to connect a signal to the oscilloscope. The probe and probe lead are shielded to prevent pickup of stray electromagnetic interference. The high input impedance of the 10X probe also minimizes signal loading in the circuit being tested.

The probe and the probe accessories should be handled carefully to prevent damage to them. Avoid dropping the probe body. Striking a hard surface can cause damage to both the probe body and the probe tip. Do not allow the cable to be crushed or kinked. Do not place excessive strain on the cable by pulling.

The standard accessory probe is a compensated 10X voltage divider. It is a resistive voltage divider for low frequencies and a capacitive voltage divider for high frequency signal components. Inductance introduced by either a long signal lead or ground lead forms a series-resonant circuit. This circuit affects system bandwidth and will ring if driven by a signal at or near the circuit's resonant frequency. Oscillations (ringing) can then appear on the oscilloscope waveform display, distorting the true signal waveshape. Always keep both the ground lead and the probe signal-input connections as short as possible to obtain the best measurement results.

Uncompensated probes are a common source of measurement error. Due to variations in oscilloscope input characteristics, probes should be compensated whenever the probe is moved from one oscilloscope to another or between channels on the same oscilloscope.

See the Probe Compensation procedure in Operator's Checks and Adjustment in this manual or consult the instructions supplied with the probe.

Coaxial Cables

Cables may also be used to connect signals to the vertical input connectors, but they can affect the accuracy of a displayed waveform. To maintain the original frequency characteristics of an applied signal, only high-quality, low-loss coaxial cables should be used. Coaxial cables should be terminated at both ends in their characteristic impedance. If this is not possible, use suitable impedance-matching devices.

INPUT-COUPLING CAPACITOR PRECHARGING

When the Input-Coupling switch is set to the GND position, the input signal is connected to ground through the input-coupling capacitor and a high-value resistance. This series combination forms a precharging circuit that allows the input-coupling capacitor to charge to the average dc voltage level of the signal applied to the input connector. Thus, any large voltage transients that may accidentally be generated are not applied to the vertical amplifier's input when the input coupling is switched from GND to AC. The precharging network also provides a measure of protection to the external circuitry by reducing the current level that is drawn from the external circuitry while the input-coupling capacitor is charging.

If AC input coupling is in use, the following procedure should be used when connecting the probe tip to a signal source that has a different dc level than the present signal source. This procedure is more important if the dc-level difference is more than ten times the VOLTS/DIV switch setting.

1. Set the AC-GND-DC (input coupling) switch to GND before connecting the probe tip to a signal source.
2. Touch the probe tip to the oscilloscope's ground connector.
3. Wait several seconds for the input-coupling capacitor to discharge.
4. Connect the probe tip to the signal source.
5. Wait several seconds for the input-coupling capacitor to charge to the dc level of the signal source.
6. Set the AC-GND-DC switch to AC. A signal with a large dc component can now be vertically positioned within the graticule area, and the ac component of the signal can be measured in the normal manner.

OPERATOR'S CHECKS AND ADJUSTMENTS

To verify the operation and basic accuracy of your instrument before making measurements, perform the following checks and adjustment procedures. If adjustments are required beyond the scope of these operator's checks and adjustments, refer the instrument to qualified service personnel.

For new equipment checks, before proceeding with these instructions, refer to Preparation for Use in this manual to prepare the instrument for the initial start-up before applying power.

INITIAL SETUP

1. Verify that the POWER switch is OFF (switch is in the OUT position), and the LINE VOLTAGE SELECTOR switch is set for the correct source voltage.
2. Plug the power cord into the ac power outlet.
3. Press in the POWER switch (ON) and set the instrument controls to obtain a baseline trace.

Display

INTENSITY	Midrange
Focus	Best defined display

Vertical (Both Channels)

Vertical MODE	CH 1
POSITION	Midrange
VOLTS/DIV	10 mV
AC-GND-DC	DC
Variable VOLTS/DIV	CAL (in detent)

Horizontal

SEC/DIV	0.5 ms
Variable SEC/DIV	CAL (in detent)
POSITION	Midrange
MAG	X1

Trigger

HOLDOFF	MIN (fully counter-clockwise)
SOURCE	VERT MODE
MODE	P-P AUTO
LEVEL	For a suitable display (with signal applied)
SLOPE	Positive
COUPLING	AC

Storage

STORE/NON-STORE	NON-STORE (OUT)
SAVE/CONTINUE	CONTINUE (OUT)
PRE-TRIG	75% (OUT)

Cursor

TRACKING	OFF (OUT)
ON/OFF	ON (IN)

4. Adjust the Vertical and Horizontal POSITION controls to position the trace within the graticule area.

5. Adjust the INTENSITY and FOCUS controls for the desired display brightness and best focused trace.

6. Allow the instrument to warm up for 20 minutes before commencing the adjustment procedures. Reduce the INTENSITY level during the waiting time.

TRACE ROTATION ADJUSTMENT

NOTE

Normally the trace will be parallel to the center horizontal graticule line, and the TRACE ROTATION adjustment will not be required.

1. Preset the instrument controls and obtain a baseline trace as described in Initial Setup.

2. Use the Channel 1 POSITION control to move the baseline trace to the center horizontal graticule line.

3. If the baseline trace is not parallel to the center horizontal graticule line, the TRACE ROTATION potentiometer needs adjusting. Use a small-bladed screwdriver or alignment tool to align the trace with the graticule line.

PROBE COMPENSATION

Probes must be compensated to match the oscilloscope inputs. For the best measurement accuracy, always check probe compensation before making measurements. Use the following procedure to check and compensate the probes.

1. Preset the instrument controls and obtain a baseline trace as described in Initial Setup.

2. Connect two 10X probes to the CH 1 OR X and CH 2 OR Y input connectors.

3. Connect the hook tip to the end of each probe.

4. Connect the CH 1 probe to the PROBE ADJUST terminal.

5. Use the CH 1 POSITION control to vertically center the display. If necessary, adjust the Trigger LEVEL control to obtain a stable display on the positive SLOPE.

NOTE

Refer to the instruction manual supplied with the probe for more complete information on the probe and probe compensation.

6. Check the waveform display for overshoot and rounding (see Figure2-14). If the probe needs to be compensated, use a small-bladed screwdriver or alignment tool to adjust for a square front corner on the waveform.

7. Take the CH 1 probe off the PROBE ADJUST terminal.

8. Connect the CH 2 probe to the PROBE ADJUST terminal.

9. Use the CH 1-BOTH-CH 2 switch to select CH 2 for display.

10. Use the CH 2 POSITION control to vertically center the display.

11. Check the waveform display for overshoot and rounding (see Figure 2-14). If compensation is needed, use a small-bladed screwdriver or alignment tool to adjust for a square front on the waveform.

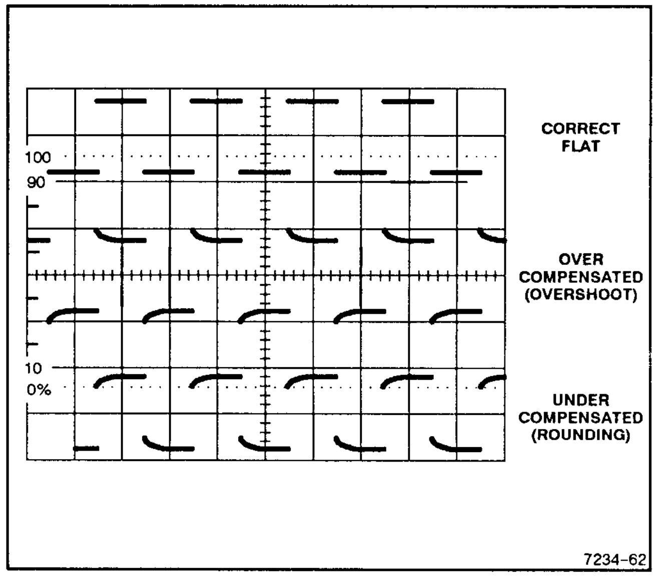


Figure 2-14. Probe compensation.

THEORY OF OPERATION

INTRODUCTION

SECTION ORGANIZATION

This section contains a functional description of the 2211 Digital Storage Oscilloscope. The discussion begins with a summary of instrument functions. Following the general description, each major circuit is explained in detail. Functional block diagrams and schematic diagrams are used to show the interconnections between parts of the circuitry, to indicate circuit components, and to identify interrelationships with the front-panel controls.

Schematic diagrams and the overall block diagrams are located in the tabbed Diagrams section at the back of this manual. The schematic diagram associated with each description is identified in the text and indicated on the tab of the appropriate foldout page by a numbered diamond symbol. For best understanding of the circuit being described, refer to both the appropriate schematic diagram and the functional block diagram.

INTEGRATED CIRCUIT DESCRIPTIONS

Digital Logic Conventions

Digital logic circuits perform many functions within the instrument. Functions and operation of the logic circuits are represented by logic symbology and terminology. Most logic functions are described using the positive-logic convention. Positive logic is a system where the more positive of the two levels is the TRUE (or 1) state; the more negative level is the FALSE (or 0) state. In this logic description, the TRUE state is HI, and the FALSE state is LO. The specific voltages which constitute a HI or a LO state vary between specific devices. For specific device characteristics, refer to the manufacturer's data book.

Linear Devices

The operation of individual linear integrated circuit devices is described in this section using waveforms or graphic techniques to illustrate their circuit action.

GENERAL DESCRIPTION

INTRODUCTION

In the following overall functional description of the instrument, refer to the basic block diagram and to the detailed block diagrams located in the foldout pages of this manual. Each major block in the diagram represents a major circuit within the instrument. In the Block Diagram the numbered diamond symbol in each block indicates the associated schematic diagram number. Much of the analog portion of the oscilloscope operates without direction from the storage or cursor readout systems. These portions of the instrument are described first, with appropriate references to areas that either provide information to or are controlled by the storage or cursor readout systems of the oscilloscope. The Storage, cursor readout and serial interface circuit discussions follow the analog circuitry description. A description of the cursor and the print/plot operations then follows.

VERTICAL

Signals to be displayed on the crt are applied to either or both the CH 1 OR X and the CH 2 OR Y input connectors. The signals may be coupled to the Attenuator either directly (DC) or through an input-coupling capacitor (AC). The inputs may also be disconnected, and the input to the Attenuators grounded, by switching to the GND position of the input coupling switch. In the GND position, the ac-coupling capacitor is allowed to pre-charge to the dc level present at the input connector. This precharging prevents large trace shifts of the display when switching from GND to AC coupling. The Attenuators are switched by the front-panel VOLTS/DIV switches to scale the applied signal level for the desired display amplitude.

The scaled output signals from the Attenuators are applied to the Vertical Preamplifiers for amplification.

The CH 2 Preamplifier has additional circuitry, permitting the operator to invert the CH 2 display on the crt. Trigger pickoffs in each channel supply a trigger signal to the Trigger Amplifier when internal triggering is selected. The final stage of the Vertical Preamplifier for each channel provides one of two signals: either the vertical channel signal for the analog presentation on the crt or the vertical acquisition signal to be digitized by the storage circuitry.

Channel signals either for direct analog presentation on the crt or for application to the Storage digitizing circuitry are selected by the analog Channel Switch under control of the front-panel Vertical MODE switches. The switching signals from the Channel Switch Logic control two transistor arrays (Channel Switch) that selects the channel signals to be applied to the Delay Line Driver. If ADD is selected in NON-STORE, both channel signals are applied to the Delay Line Driver where the signals are summed together.

The Delay Line Driver provides the proper signal-driving level and impedance match to the Delay Line, where the vertical signal is delayed approximately 90 ns with respect to the trigger signal. This delay allows time for the Horizontal circuitry to start the sweep before the vertical signal is applied to the crt thus enabling the operator to see the trigger point.

In STORE mode and when cursor/readout information is written to the crt, the analog display signal from both the Vertical Preamplifier stages to the delay line drivers is biased off under control of the Channel Switch Logic. The CH 1 and CH 2 acquisition signals from the final preamplifiers to the storage circuits are then turned on and the analog signals from the vertical DAC circuitry are supplied to the Delay Line Driver.

Final amplification of the vertical signal (either STORE, NON-STORE or cursor/readout) is done by the Vertical Output Amplifier. This stage produces the signal levels that vertically deflect the crt electron beam. This amplifier stage also contains the vertical trace separation circuitry that separates the reference trace from the last acquired waveform when in STORE mode. The amount of separation is controlled using the front panel TRACE SEP knob. The upper frequency response of the amplifier can be reduced by enabling the X10 GAIN circuitry. For locating the position of off screen displays the dynamic range of the amplifier can be limited with the Beam Find circuitry. This circuit also intensifies the trace and also limits the horizontal deflection.

TRIGGERING

The Triggering circuitry uses either the internal Trigger signal obtained from the input signal(s), an External Trigger signal or a Line Trigger signal derived from the ac-power-source to develop trigger signals for the Sweep Generator. The negative and positive peak rectifiers in the Trigger circuitry set the range of the Trigger LEVEL control to conform approximately to the peak-to-peak amplitude of the selected trigger signal when either AUTO or TV FIELD Trigger MODE is selected. In NORM mode, the Trigger LEVEL control must be adjusted to the signal level before a sweep will be triggered. ROLL Storage (selectable at the slower speeds in STORE mode) is an untriggered display where a continuous signal acquisition is made and the signal displayed without the need of a trigger signal. However in ROLL SGL SWP mode, it is possible to have a triggered display.

The triggering circuitry contains the TV Field Sync circuit. This circuit provides stable triggering on television vertical-sync pulses when in the TV FIELD triggering mode. TV LINE triggering is possible using P-P AUTO Trigger MODE.

SWEEP LOGIC

The Sweep Logic circuit controls NON-STORE sweep generation and Z-Axis unblanking for the sweep display. When the Trigger MODE switches are set to either P-P AUTO or TV FIELD, and no trigger signal is present, the Auto Baseline Generator circuit causes the Sweep Logic circuit to produce a sweep for reference purposes. In NORM Trigger MODE, the Auto Baseline circuit is disabled and NON-STORE sweeps are not generated until a trigger event occurs. NORM Trigger MODE is used to obtain stable triggering on low-repetition rate signals that do not provide a trigger before an auto baseline is generated. SGL SWP (single sweep) Trigger MODE allows only one sweep to be generated after being reset and is used to obtain the waveform from a one-shot event.

ROLL and RECORD Storage modes are useful in capturing low-frequency and low-repetition rate waveforms. In RECORD mode a complete acquisition is obtained before the data is displayed. In ROLL mode however, the display is continually updated with new data as it is acquired with latest data appearing on the right hand side of the screen. The Sweep Logic circuitry provides all the gating and holdoff signals used in Storage mode.

TIME BASE

In NON-STORE mode, the Sweep Logic circuit controls the operation of the Miller Sweep generator. The sweep circuit produces a linear ramp with a time that is controlled by the SEC/DIV switch setting.

In STORE mode, the Storage Ramp Generator produces a constant ramp that is not a function of the SEC/DIV switch setting. This ensures a constant intensity display. Further control over the Storage Ramp Generator is provided for displaying the trigger point and for the retrace period.

In the NON-STORE X-Y mode of operation, the CH 1 signal from the internal Trigger circuitry passes through the X-Y amplifier. In this operating mode, the CH 1 Internal Trigger signal supplies the horizontal deflection to the crt, and the Miller Sweep circuit is disabled to inhibit sweep generation. There is no STORE X-Y display mode.

HORIZONTAL

The X-Axis signal (sweep, storage ramp, or X-Y signal) is applied to the Preamplifiers in the X-Axis Amplifiers for initial amplification and then to the Horizontal Output Amplifier to drive the crt deflection plates. The X1/X5 MAG and X1/X10 MAG preamplifier gain is increased by a factor of either 10 or 50 when the Horizontal MAG control is used. Horizontal positioning of the display is accomplished in the Horizontal Preamplifier circuits.

STORAGE BOARD

The Storage board consists of a complete Digital Acquisition and Display system with separate Acquisition and Display RAM. In STORE mode, analog signals are picked off from the Vertical Amplifiers and level shifted by the interface circuit before being digitized by the A/D Converters. Data is written into the Acquisition RAM by the Acquisition Control System at a rate determined by the Digital Time Base.

The Digital Time Base output is a function of the front-panel switch settings. Two counters are used in the acquisition process to determine the relevant amount of pre- and post-trigger data. In RECORD mode, after acquisition the data is transferred to the Display system for display from the Display RAM. In ROLL mode, data is displayed directly from the Acquisition RAM under control of the Display Controller and the Acquisition Controller. The Display Controller outputs data to the Vertical DAC circuit. The output of the DAC circuit in turn drives the analog vertical deflection circuitry. Both controllers obtain status information of the analog circuitry from the Status Latches. The Display Controller also controls the Z-Mod circuit to control the Z-Axis and blanking circuit of the crt.

ACQUISITION

Input signals to be digitized are selected by the Channel Switch. Either or both (for ADD) of the input signals picked off from the Vertical Preamplifier may be selected. The differential output signal from the Channel Switch is converted to a single-ended signal by the interface circuit before being applied to the A/D Converters.

The outputs of the A/D Converters are 8-bit digital words that are latched and then written into the Acquisition RAM. The acquisition memory is composed of two, 8k by 8-bit random-access memory devices. One 4k block is used for each channel.

A programmable Address Counter is loaded with a number that corresponds to the selected amount of pretrigger data (either 25% or 75%) that is required. When sufficient data has been obtained to satisfy the pretrigger data requirement the PRE_FUL signal is generated to enable the trigger circuit. A programmable Record Counter is loaded with a number that corresponds to the amount of post-trigger data that is required. In RECORD mode, when a trigger is received the Record Counter is enabled and clocked until it generates an EOR signal. The EOR (end-of-record) signal terminates the acquisition.

Acquisition is controlled by two state machines, one for the RECORD mode and another for ROLL mode. In RECORD mode, at the end of an acquisition the Address Counter is effectively loaded with the start address of the new data record. Control is then passed over to the Display Controller which transfers the data to the Display RAM. In ROLL mode, data is displayed direct from the Acquisition RAM which are themselves clocked from the Display Controller. When a new data sample is available, the present display address is latched in the Display Address Register, and the current acquisition address is obtained from the Acquisition Address Register. The new data sample is then stored in the Acquisition Memory with the Display system being inhibited until the current save cycle is completed. On completion of the save cycle, the next display address is recovered from the Display Address Register, and the Display system continues displaying data from the next relevant display point.

DIGITAL TIME BASE

The timing signals for the storage board are derived from an accurate, 40 MHz quartz-crystal oscillator. This signal is divided down to give a 20 MHz master-clock signal which is used for all the state machine and logic synchronization. The Time Base circuit also generates A/D CONV_CLK and SAV_CLK(L) (the sample rate clock). A programmable divider chain is used to generate the SAV_CLK (L) signal for all SEC/DIV settings slower than 50 μs per division.

A Clock Multiplexer at the end of the Time Base Divider chain selects the output of the Time Base Divider, the CONV clock, or an external clock signal to generate the SAV_CLK(L) signal.

The Time Base also includes an external clock buffer circuit that conditions an external clock input so that it does not violate digital logic levels.

DISPLAY

The Display system consists of the Display Controller, Display RAM, Vertical Output Interface, and Display Counter. In RECORD mode, the Display RAM is cycled through under control of the Display Counter which, in turn, is clocked and controlled by the Display Controller.

The Display Controller consists of three state machines and associated controlling logic that provides decoding and keeps track of the status flags. The three state machines are: Display States, Block States, and the Display Timing Generator.

The Display State Machine controls the digital sweeps and the trigger point display. The Block State Machine determines the activity that will take place in the next digital sweep (Block). Decisions are made at the end of each sweep before the next sweep starts. The operation of the Display State Machine and the Block State Machine are mutually exclusive; one is idle while the other runs.

The Display Timing Generator runs whenever a storage sweep is in process to provide the clocks needed for the storage sweeps and the RAM data transfers.

Output data from the Display RAM is latched into the Vertical DAC latch by the Display Controller. The output of the DAC latch drives the Vertical Digital-to-Analog Converter and hence the vertical drive circuitry. Each of the channel displays is a 4k block of data with the least significant address always representing the left hand side of the screen. The most-significant address, indicated by 4K_TC, always represents the right hand side of the screen.

The contents of the RAM location determine the vertical deflection and hence the vertical data. Clocking of the Display Counter is at a constant 1 MHz rate, making the readout rate or display rate of the data also 1 MHz. Each block of data takes just over 4 ms to be read out and is separated from the next block of data by a sweep retrace.

When the waveform data is displayed, the data point corresponding to the trigger position in the waveform is highlighted (intensified). The trigger point is brightened by holding the horizontal deflection at the point for longer than normal. The horizontal drive for the Storage system is obtained from the Storage Ramp Generator. The output ramp is synchronized to data readout by GATE_STORE.

The Display Memory consists of two RAM organized as two, 8k by 8-bit memories (Waveform RAM and Reference RAM). The first 8k is used for the display of CH 1 and CH 2 data while the second 8k is used for storing two Reference traces. The Reference traces are displayed from the Reference RAM in the Display Memory in both RECORD and ROLL modes is selected. However, in ROLL mode, the channel data is read out directly from the Acquisition RAM and not the Waveform RAM.

CURSOR AND READOUT BOARD

The display of Cursor measurements and front panel control settings on the CRT display are controlled by the Cursor/Readout board. These circuits generate horizontal (X) and vertical (Y) deflections for the 'pixels' (Cursor or character elements) and control timing of the display of these pixels. There is an exceptional case; STORE mode Time Cursors, where the timing of the cursor segments is generated by counters located on the Serial Interface board.

The Cursor/Readout Central Processor Unit (CPU) reads certain front panel control settings and levels. It extracts information to be displayed on the CRT and controls the STORE mode digital timebase. The Cursor/Readout CPU can assert a signal requesting the Serial Interface CPU to allow read or write access to a segment of shared Random Access Memory (RAM).

The Cursor/Readout CPU can display test patterns and readout displays on the CRT that are of use in calibration and fault diagnosis of the 2211.

SERIAL INTERFACE BOARD

Waveform and Reference displays can be converted into formats for transmission over an RS-232-C compatible interface. The Serial Interface Central Processing Unit (CPU) can read a segment of Random Access Memory (RAM) which contains a copy of the waveform and reference trace displays. It can read from and write to a serial port compatible with RS-232-C and based on the IBM PC-AT™ pinout.

The Serial Interface CPU has read or write access to a segment of RAM shared with the Cursor/Readout CPU.

The Serial Interface board is host to a circuit which controls the display timing of STORE mode time cursor segments.

Z-AXIS

The Z-Axis drive signal, from either the Sweep Logic circuit or the cursor/readout board, is applied to the Z-Mod Amplifier. The output signal from the Z-Mod Amplifier circuit sets the crt intensity. When using Chop Vertical mode, a blanking signal from the Chop Oscillator circuit (part of the Vertical Preamp circuit) blanks the crt display while switching between vertical channels.

The Grid Bias DC Restorer circuit applies the output voltage of the Z-Mod Amplifier between the cathode and grid of the crt. High dc-voltage potentials on these elements prohibit direct coupling to the crt.

POWER SUPPLY

The Power Supply provides the necessary operating voltages for the instrument. Operating potentials are obtained from a circuit consisting of the Power Transformer, Preregulator, Inverter and multiwinding Transformer. The voltage produced by the Power Transformer output winding, after rectification, provides 45 Vdc minimum to the 40 kHz Preregulator circuit. The Preregulator circuit in turn supplies a nominal 38 Vdc to the 20 kHz inverter stage. A high-voltage multiplier circuit provides the accelerating, focus and cathode potentials used by the crt.

PROBE ADJUST

A front-panel PROBE ADJUST output is provided for use in adjusting probe compensation. The voltage at the PROBE ADJUST connector is a negative-going square wave with a peak-to-peak amplitude of approximately 0. 5 V at a repetition rate near 1 kHz.

DETAILED CIRCUIT DESCRIPTION

ATTENUATORS AND PARAPHASE AMPLIFIERS (diagram 1)

Attenuators

The CH 1 and CH 2 Attenuator circuits are identical with the exception of the additional Invert circuitry in the CH 2 Paraphase Amplifier. Therefore, only the CH 1 Attenuator is described, with the Invert circuitry of CH 2 discussed separately.

The Attenuator circuit (see Figure 3-1) provides control of the input coupling, the vertical deflection factor, and the Variable VOLTS/DIV gain. Vertical input signals for display on the crt may be connected to either or both the CH 1 or X and the CH 2 or Y input connectors. In X-Y mode of operation, the signal applied to the CH 1 or X connector provides horizontal (X-axis) deflection for the display, and the signal applied to the CH 2 or Y connector provides the vertical (Y-axis) deflection for the display.

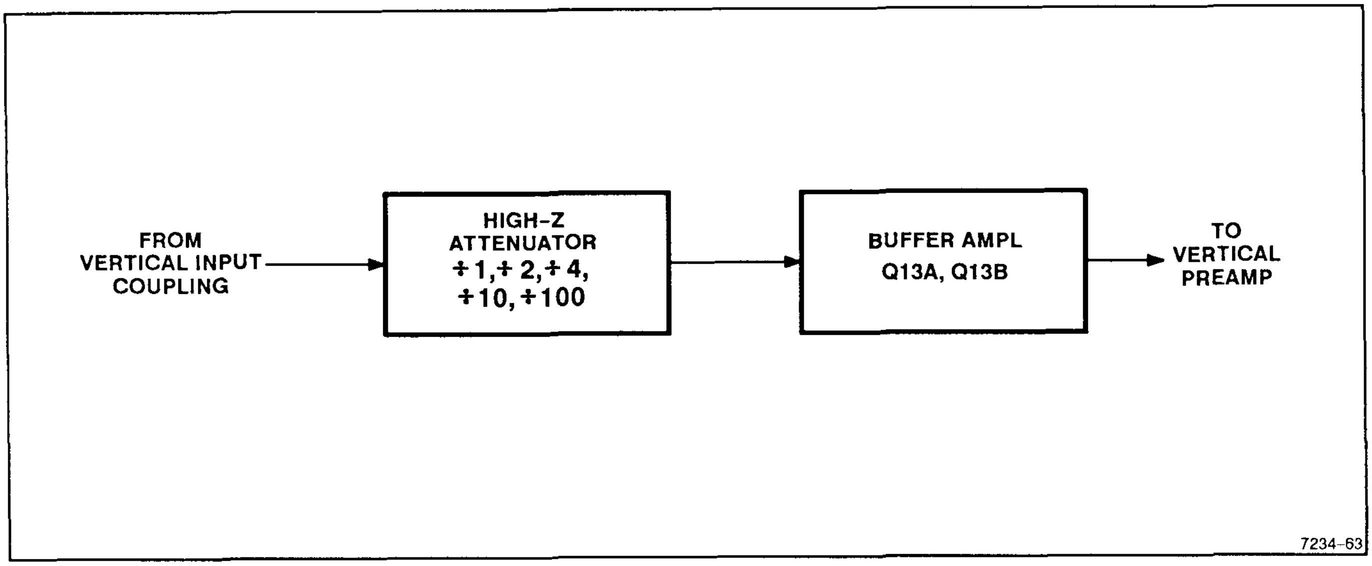


Figure 3-1. Block diagram of the Channel 1 Attenuator circuit.

Input Coupling (AC-GND-DC)

A signal from the CH 1 OR X input connector, shown on diagram 10, may be ac or dc coupled to the High Impedance Attenuator circuit (AT1) or disconnected completely by the Input Coupling Switch, S101. Signals from the CH 1 OR X input connector are routed through resistor R1 to the Input Coupling Switch. When S101 is set for dc coupling, the CH 1 signal goes directly to the input of the High Impedance Attenuator. When ac coupled the input signal passes through dc-blocking capacitor C2. The blocking capacitor stops the dc component of the input signal from reaching the Attenuator circuit. When switched into the signal path, Attenuator AT1 attenuates the input signal by factors of 100, 10, 4, or 2. When S101 is set to GND, the direct signal path is opened, and the input of the attenuator is connected to ground. This provides a ground reference without the need to remove the applied signal from the input connector. The coupling capacitor precharges through R4 to prevent large trace shifts when switching from GND to AC. To update the crt readout, the AC position of the Input Coupling Switch is detected and fed to the shift register U1408 (diagram 13), via line CH1_AC(L).

A probe coding ring on the CH1 OR X input connector is used to read the attenuation factor of the attached probe to automatically adjust the VOLTS/DIV scale factors in the readout. Components R1440, R1441, R1442 and VR1441, shown on diagram 3, together with the probe, set the voltage to the analog to digital convertor (diagram 41). The default setting is for X1 attenuation when either coaxial cables or uncoded probes are connected to the vertical inputs.

Input Attenuator

The effective overall deflection factor of each vertical channel is determined by the setting of the Channel VOLTS/DIV switch. The basic deflection factor of the Vertical system is 5 mV/DIV. For VOLTS/DIV switch settings above 5 mV, frequency compensated voltage dividers (attenuators) are switched into the circuit. Each channel has 2X, 4X, 10X and 100X attenuators that are selected in various combinations to produce the indicated deflection factor. Each attenuator contains adjustable capacitors to compensate for correct attenuation at high frequencies. To update the crt readout, each position of the attenuator switch is uniquely decoded and fed to shift register U1402.

Source Follower

The CH 1 signal from Input Attenuator AT1 is connected to source follower Q13B via R6 and C6. Resistor R5 provides the input resistance. FET Q13A is a constant current source for Q13B. FETs Q13A and Q13B provide a high input impedance for the attenuator stage and the output drive current needed for Paraphase Amplifier U30 (the first stage of amplification).

In the event that excessive high-amplitude signals are applied to FET Q13B the signal will be limited by CR7 and the gate-source junction of Q13B. If an excessive negative-going signal causes CR7 to become forward biased, the gate of Q13B is clamped to approximately -9. 3 V. An excessive positive-going signal will forward bias the gate-source junction of Q13B. As soon as gate current flows, the gate voltage will stop increasing. Gate current is limited by the high resistance of R6.

Paraphase Amplifier

Paraphase Amplifier U30 converts the single-ended signal from Q13 into a differential signal for the Vertical Preamplifier. The signal from Q13A pin 2 goes to the base of one transistor in U30. The other input transistor in U30 is biased by the divider network formed by R30, R31, R32, and potentiometer R33. Emitter current for the two input transistors is supplied by R22 and R23. Resistor R29 sets the gain for the stage. The network formed by C8 and R9 reduces the substrate capacitance of Q13 at high frequencies. Resistor R8 biases the diode substrate of Q13 off. The collector current of the two input transistors serves as emitter current for the differential output transistor pairs. Base bias voltages for the output pairs are developed by the divider network formed by R39, R41, R42, and the Variable VOLTS/DIV potentiometer. The transistors of U30 have matched characteristics, so the ratio of currents in the two transistors connected as diodes, U83C and U83D, determines the current ratios in the output transistor pairs of U30.

As the Variable VOLTS/DIV potentiometer (part of AT1) is rotated from calibrated to uncalibrated, the conduction level of the transistors connected to R35 increases. Since the transistor pairs are cross connected, the increased conduction in one pair of transistors subtracts from the output current produced by the transistor pair connected to R38, and the overall gain of the amplifier decreases. Balance potentiometer R33 is adjusted to balance the amplifier for minimal dc trace shift as the CH 1 Variable VOLTS/DIV control is rotated. To update the screen readout, the calibrated position of this control is detected and fed to shift register U1400.

Incorporated in the CH 2 Paraphase Amplifier is circuitry that allows the user to invert the polarity of the CH 2 signal. When CH 2 INVERT switch S90 is selected for NORM, the transistor pairs in U80 are biased as they are in U30, and the CH 2 trace is not inverted. For the CH 2 INVERT position of S90, connections to the bases of the output transistor pairs are reversed, reversing the polarity of the output signal to produce an inverted CH 2 trace. Invert Balance potentiometer R83 is adjusted for minimal dc trace shift when rotating the CH 2 Variable VOLTS/DIV control in CH 2 INVERT mode. Balance potentiometer R84 is switched in with R83 when in NORM; it is adjusted for minimal dc trace shift when rotating the CH 2 Variable VOLTS/DIV control. The INVERT position is detected and level shifted by components R1489 and R1490 before being fed to shift register U1400.

VERTICAL PREAMPLIFIERS AND CHANNEL SWITCHING (diagram 2)

Vertical Preamplifiers

The CH 1 and CH 2 Vertical Preamplifiers are identical in operation. Operation of the CH 1 amplifier is described. Differential signal current from the Paraphase Amplifier is amplified to produce drive current for the Delay Line Driver. Internal trigger signals for the Trigger circuitry are picked off prior to the Vertical Preamplifier. The Channel Switch circuitry controls channel selection for the crt display (see Figure 3-2). Two differential current sources maintain equal common-mode currents to the delay line driver under all channel switching conditions.

Common-base transistors Q102 and Q103, which complete the Paraphase Amplifier portion of the circuitry shown on diagram 1, convert differential current from the Paraphase Amplifier into level-shifted voltages that drive the bases of the input transistors of Vertical Preamplifier U130 and the Internal Trigger circuitry.

Common-mode components CR104, CR105, R104 and R105 define X1 gain. X10 gain is selected by switching in CR111, CR112, R107, R110, R111, R112, and R128. X10 gain is adjusted by R112, and X10 balance is set by R107. Bandwidth in X10 mode is limited to between 5.2 MHz and 7. 8 MHz by C110. The X10 position is detected and level-shifted by components R1433 and R1434 before being fed to shift register U1400.

Emitter current for the input transistors of U130 is supplied by Q114 and Q115. The base bias voltage to Q114 and Q115 is unbalanced through potentiometer R123 (the CH 1 POSITION control) to produce vertical positioning of the CH 1 trace.

The collector current of each input transistor flows through either of the two differential output transistors dependent upon which is turned on. One of the collectors supplies half the drive to the Acquisition circuitry on the Storage board, and the other feeds the Delay Line Driver on diagram 3.

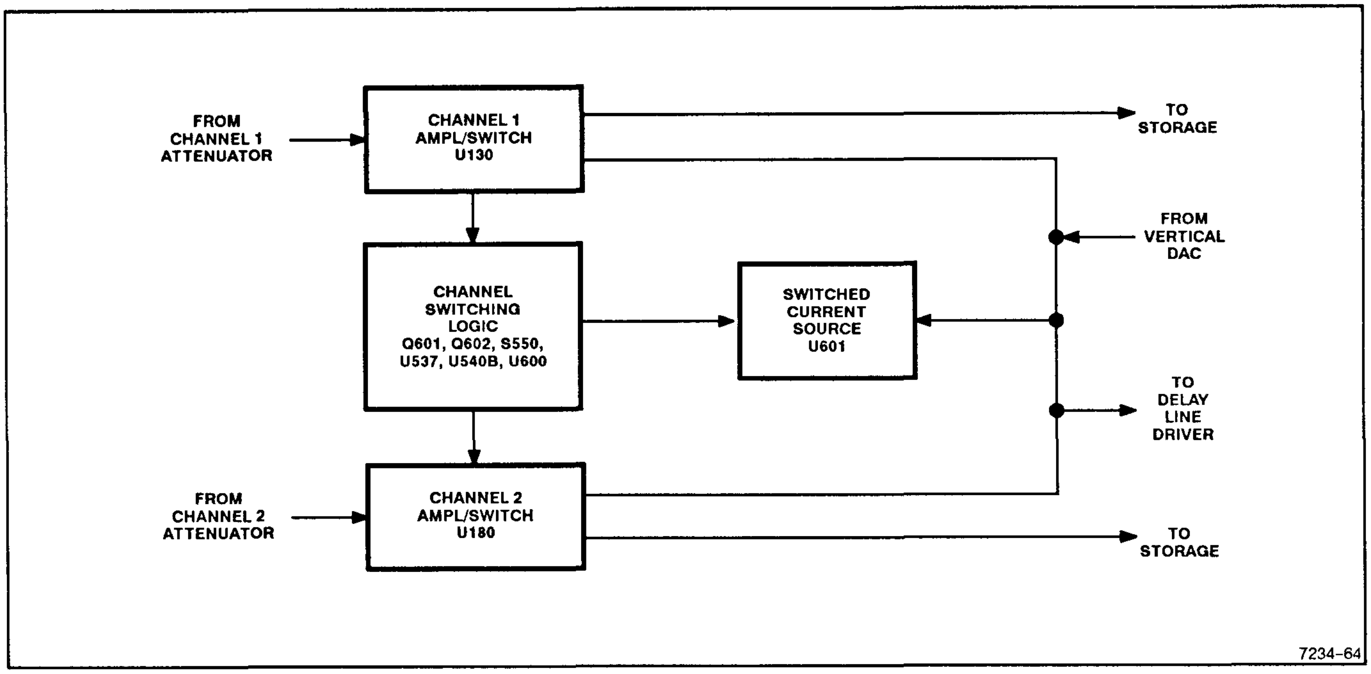


Figure 3-2. Block diagram of the Channel Switching circuit.

Channel Switching

Since the STORE and CR_YDAC_EN lines are OR'ed at the base of emitter follower Q601, the channel switching operation will be the same for STORE mode or with READOUT on, and for NON-STORE mode or with READOUT off.

NON-STORE MODE/CRT READOUT OFF. In NON-STORE mode with the crt readout switched off, the emitter of Q601 will be LO and hence the output of open-collector buffer U600F will be HI and Q602 will be turned on. If channel 1 is selected as the drive to the Delay Line Driver, the Q output (pin 9) of U540B is HI, and the output of buffer U600E is also HI. The transistors in U130 that feed the Delay Line Driver (the ones connected to R138) are turned on. The other two transistors have their bases driven via R136 from Q601 and are therefore turned off. CH 1 is therefore connected to the Delay Line Driver, and no signal is fed to the CH 1 acquisition circuit.

U601 consists of a pair of differential amplifiers configured as two switched current sources. If CH 1 is switched on and CH 2 is switched off, the current source in U601 whose collector transistors are connected to R136 and R138, supplies its current to ground. The source whose collector transistors are connected to R186 and R188, supplies its current to the delay line driver. This maintains the common mode current that would otherwise have been supplied if both channels were switched on. The base potentials for the current sources in U601 are derived from the average voltages across the vertical position controls, picked off by R610 and R611 for CH 1, and R660 and R661 for CH 2.

The gain of the preamplifier is set by CH 1 Gain Potentiometer R145. The adjustment controls the signal current that is shunted between the two differential outputs.

If CH 2 is selected instead, the other two transistors in U130 will conduct, sending the CH 1 signal to the acquisition circuit (where it is ignored because the instrument is in NON-STORE). In this case the Delay Line Driver will be driven by the two transistors in U180 that have their bases connected to R188, and also the current source whose collector transistors are connected to R136 and R138.

STORE MODE/READOUT On. If STORE mode or READOUT is selected, Q602 is biased off by U600F, so that the open-collector buffers (U600D and U600E) have no effect because their outputs have no pull-up. In this case the transistors in U130 and U180 which are connected to R603 and R653 are permanently turned on so that CH 1 and CH 2 signals are sent to the CH 1-ACQ and CH 2-ACQ circuits respectively, instead of the Delay Line Driver. Both current sources in U601 are connected to the delay line driver so as to maintain the common-mode current. The vertical DAC amplifier is switched to supply the delay line driver with differential signal currents carrying STORE or READOUT information.

CHANNEL SWITCHING. The Channel Switching circuitry uses the setting of the front-panel Vertical MODE switches (see diagram 10) to select the vertical signal to be displayed or routed to the Storage board (S545, ADD-ALT-CHOP and S550, CH 1-BOTH-CH 2).

When any display mode other than X-Y is selected, the XY line connected to S550 is at ground potential. Vertical MODE switches S545 and S550 control the connection between the XY control line and the SET and RESET inputs of flip-flop U540A (SET and RESET are active LO) to obtain the various display formats.

CHANNEL 1 DISPLAY ONLY. The CH 1 position of S550 grounds the SET input of U540B while the RESET input is held HI by pull-up resistor R539. This sets U540B and produces a HI and a LO on the Q and $\overline{Q}$ outputs respectively, and hence a HI and a LO on pins 10 and 8 respectively of U600. The CH 1 Preamplifier signal then drives the Delay Line Driver (as described in the Vertical Preamplifier section). The CH 2 Preamplifier will be disabled. The CH_1(L) control line is fed to shift register U1408.

CHANNEL 2 DISPLAY ONLY. The CH 2 position of S550 holds the RESET input of U540B LO through CR538, and the SET input is held HI by pull-up resistor R538. This resets U540B, making its Q output LO and the $\overline{Q}$ output HI. U600 pins 10 and 8 will be LO and HI respectively. The CH 2 Preamplifier signal is then enabled to drive the Delay Line Driver, while the CH 1 Preamplifier is disabled. The CH2_(L) control line is fed to shift register U1408.

To display the ADD, ALT, or CHOP formats, S550 must be in the BOTH position to ground the middle pins of S545.

ADD DISPLAY. In the ADD position of S545, both the SET and RESET inputs of U540B are held LO by CR534 and CR537 (diagram 10). This forces the Q and $\overline{Q}$ outputs of U540B both HI, and signal currents from the CH 1 and CH 2 Preamplifiers add together to drive the Delay Line Driver.

CHOP DISPLAY. In the CHOP position, the CHOPEN(L) line is held LO, keeping the output of inverter U600A HI. This enables CHOP multivibrator U537D to begin switching. The switching rate is determined primarily by the component values of R544, R545, and C545. The inverted output of the multivibrator circuit, U537C pin 8, supplies the CHOP clock to flip-flop U540B via U537B. The output of U537C also supplies the CHOP clock to the Chop Blanking circuit. The CHOPEN(L) control line is fed to shift register U1408.

In the Chop Blanking circuit, coupling capacitor C547 and resistors R547 and R548 form a differentiating circuit that produces positive-going and negative-going short duration pulses. These pulses are inverted by U537A to generate the CHOP BLANK signal to the Z-Mod Amplifier. The pulses blank the crt during CHOP switching times.

In NON-STORE, CR_YDAC_EN is differentiated by C608 and R608, and the resulting pulses are inverted by U547A to generate readout blanking information for the Z-Mod Amplifier. These pulses blank the crt during NON-STORE trace and readout switching times.

The ALT_SYNC(L) signal applied to one input of U537B is HI except during Holdoff. This allows the output of U537C to be inverted by U537B to drive the clock input of flip-flop U540B. Since the $\overline{Q}$ output of U540B is connected back to the D input, and both SET and RESET inputs are HI (unasserted), the outputs of U540B toggle (change states) with each clock input. The Delay Line Driver is then driven alternately from the CH 1 and CH 2 Preamplifiers at the CHOP rate.

ALTERNATE DISPLAY. In ALT Vertical MODE, the CHOPEN(L) line is held HI, disabling CHOP multivibrator U537D and the output of U537C will be HI. Input signals to U537B are the HI from U537C and the ALT_SYNC(L) signal from the Holdoff circuitry in the Sweep Logic. The output of U537B will then be the inverted ALT_SYNC(L) signal that clocks Channel Select flip-flop U540B. This causes the outputs of U540B to toggle at the end of each sweep so that the CH 1 and CH 2 Preamplifiers alternately drive the Delay Line Driver.

VERTICAL OUTPUT AMPLIFIER (diagram 3)

Delay Line Driver

The Delay Line Driver, shown on diagram 3, converts the signal current from the Vertical Preamplifiers and the vertical DAC amplifier into a signal voltage for input into the Delay Line. Transistors Q202, Q203, Q206, and Q207 form a differential shunt feedback amplifier with the gain controlled by R216 and R217. Common-mode dc stabilization of the Delay Line Driver is provided by U225. Should the voltage at the junction of R222 and R223 deviate from zero, U225 will change the base current to Q202 and Q203 (through R202 and R203) to return the outputs of the Delay Line Driver to an average dc value of zero volts. Q200 and Q201 act as clamps to limit the output signal voltages from the shunt feedback amplifier. Delay Line DL224 provides a vertical signal delay of approximately 90 ns. The delay permits the Sweep Generator to start a sweep before the vertical signal that triggered the sweep can reach the vertical deflection plates, and the leading edge of the trigger signal can be viewed.

Vertical Output Amplifier

The Vertical Output Amplifier drives the vertical deflection plates of the crt. Signals from the Delay Line go to a differential amplifier formed by Q230 and Q231 with low- and high-frequency compensation provided by the RC networks between the emitters. Thermal compensation is provided by thermistor RT236, and overall circuit gain is set by R233. Transistors Q284 and Q285 form the current sources for the amplifier, and Q232 and Q233 limit the output. Potentiometer R294 sets the biasing of the current sources for minimal thermal distortion.

The output stage of the amplifier is two, compound-shunt transistor pairs, Q254-Q256 and Q255-Q257. The output stage converts the collector currents of Q230 and Q231 to proportional output voltages. Resistors R256 and R257 serve as feedback elements. High-frequency compensation is provided by C256 and C257.

Vertical Beam Find

Beam Find is used to reduce the vertical trace deflection to within the graticule area for locating off-screen and over-scanned traces. The BEAM FIND voltage from switch S390 (diagram 10) adjusts the Delay Line Driver amplifier biasing to limit the voltage swing at the crt plates. When S390 is in the normal position (not pressed), the BEAM FIND voltage level on R226 is about 0. 4 V. When the BEAM FIND switch is pressed, the voltage level on R226 goes to about -8. 6 V. This level forces the output of U225C LO and biases Q202 and Q203 to limit the dynamic range of the amplifier. Q200 and Q201 are biased off so as not to reduce the range excessively.

Reference Position Control

The circuit consisting of Q277, Q283 and associated components provides a means of vertically positioning the Reference waveform with respect to the normal trace when in STORE mode. During the Reference waveform display interval and when no readout information is being displayed, the REF_POS(L) and CR_YDAC_EN signals from the Storage and Cursor/Readout systems are LO, and Q283 is biased off. This allows REFERENCE POSITION potentiometer R280 (diagram 10), to control the conduction level of Q277. This transistor supplies a dc offset current to one side of the delay line driver that changes the position of the Reference trace on the screen.

During the normal sweep interval the REF_POS(L) signal is HI (unasserted), and Q283 is biased on. This transistor then diverts the current that is flowing through Q277 away from the delay line driver, and equal current is supplied to both sides of the amplifier so that no offset of the trace occurs. The same action occurs if cursor/readout information is to be displayed, in which case CR_YDAC_EN is HI. When REF_POS(L) is asserted and CR_YDAC_EN is unasserted (i.e. no cursor readout information is being displayed), Q283 is biased off. The current flowing through Q277 then flows into one side of the delay line driver which offsets the trace by an amount determined by the position of R280 (REFERENCE POSITION) in the base circuit of Q277. A voltage proportional to the offset current is picked off from Q277 emitter and passed to the host interface of the cursor/readout system (diagram 41).

TRIGGER (diagrams 4 and 5)

The Trigger Amplifier provides signals to the Trigger Generator from either the Vertical Preamplifiers, the EXT INPUT connector, or the power line. The COUPLING switch selects AC, DC, LF REJECT or HF REJECT trigger-signal coupling. The SOURCE switches select between CH 1, CH 2, line, or external trigger sources.

Storage Pickoffs

The trigger logic (diagram 5) provides signals to the Storage Board indicating the status of the front panel trigger controls. CH1_TRIG, which originates from U300B shows that the next trigger signal will be from CH 1. The corresponding signal from U300A shows that the next trigger will be from CH 2, but is modified by diodes CR475, CR474, CR476, and CR477. When EXT trigger is selected, both CH1_EN(L) and CH2_EN(L) are HI, CR476 conducts, pulling CH2_TRIG HI.

Internal Trigger

Signals from the Vertical Preamplifiers drive the CH 1 and CH 2 Internal Trigger Amplifier with channel selection determined by the Vertical and Horizontal MODE switches. Trigger pickoff from the Preamplifiers is accomplished by Q106 and Q107 for CH 1 and Q156 and

Q157 for CH 2. The circuitry associated with CH 2 is the same as CH 1 except that it has a trigger-offset adjustment.

Differential vertical signals from the CH 1 Preamplifier go to Q106 and Q107 shown on diagram 4. These transistors each drive one input transistor in U335. The collectors of the U335 input transistors in turn supply emitter current to two pairs of current-steering transistors. The biasing network connected between the emitters of the input transistors in U335 is fixed for CH 1 but not for CH 2. Potentiometer R316 in the emitter circuit adjusts the bias levels of the two input transistors to match the dc offsets of the CH 1 and CH 2 Trigger Amplifiers.

One transistor in each side of the output differential amplifier pairs of U335 has its bias set to zero volts. The bias voltage of the other transistor in each pair is controlled by the CH1_TRIG signal from the Trigger Switch circuitry. When the CH1_TRIG signal is LO, the transistors in each output pair with the collectors connected together are biased on, and the other transistors in the output pairs are off. The collector signal currents of the conducting transistors are equal in magnitude but of opposite polarity, so signal cancellation occurs. When the CH1_TRIG signal is HI, the other transistors in each pair are biased on, and a differential signal is developed across output load resistors R339 and R340 to drive the Internal Trigger Amplifier.

Internal Trigger Amplifier

Internal trigger channels are chosen by the SOURCE switch (diagram 10) being set to CH 1, VERT MODE, or CH 2. The logic function required to generate CH1_TRIG and CH2_TRIG is performed by U300, U304, CR300, CR301 and CR302. External Trigger is selected by the SOURCE switches being set to EXT, and EXT=Z or EXT or EXT/10. Line Trigger is selected by the SOURCE switches being set to EXT and LINE.

CHANNEL 1. When the Trigger SOURCE is set to CH 1, CH 1 is the trigger source whether displayed or not. The CH 1 signal is also the trigger source under other settings of the Trigger SOURCE and Vertical MODE switches that call for the CH 1 signal to be displayed. Those conditions are:

Trigger SOURCE set to VERT MODE and the Vertical MODE set to CH 1, or

Trigger SOURCE set to VERT MODE and the Vertical MODE set to BOTH and ALT.

The control line CH1_EN(L) is level shifted by R1411-3 and R1435 before being fed to shift register U1406.

CHANNEL 2. When the Trigger SOURCE is set to CH 2, then CH 2 provides the trigger signal whether CH 2 is displayed or not. As with CH 1, other Trigger SOURCE and Vertical MODE settings will call up the CH 2 trigger signal when CH 2 is displayed. Those conditions are:

Trigger SOURCE set to VERT MODE and the Vertical MODE set to CH 2, or

Trigger SOURCE set to VERT MODE and the Vertical MODE set to BOTH and ALT.

The control line CH2_EN(L) is level shifted by R1411-2 and R1437 before being fed to shift register U1406.

VERT MODE. When the SOURCE switch is set to VERT MODE, the trigger source selection is determined by the Vertical MODE switch. A Vertical MODE of CH 1, CH 2, and BOTH in ALT are described above. A Vertical MODE of BOTH in ADD or CHOP results in the trigger source being the arithmetic sum of CH 1 and CH 2 input signals.

EXT. When the SOURCE switches are set to EXT and either EXT=Z or EXT, the trigger source is the signal applied to the EXT INPUT or Z connector. With EXT and EXT/10 selected, the trigger signal is as above but attenuated by a factor of 10. With EXT and LINE selected, the line-frequency signal, generated in the power supply, is passed to the External Trigger Input Amplifier (shown on diagram 10). In each case, the buffer consisting of Q370A and Q370B drives differential amplifier U340. This amplifier has the same form as the CH 1 and CH 2 preamplifiers. External offset adjustment is provided by R360. The LO logic signal generated by U308B, EXTEN(L), switches on the external trigger path.

Trigger Amplifier

The Trigger Amplifier (diagram 4) converts the differential signals from the Vertical and External Preamplifiers into a single-ended analog trigger signal that drives the X-Axis Amplifier (for X-Y Mode displays) and the Trigger Generator.

Transistors Q363 and Q365 act as a cascade stage to add the signals passed by the preamplifiers to the offset current provided (via R397 and R398) by the coupling control amplifiers. The resulting differential output drives the differential pair of Q366 and Q367. The collector load of transistor Q367 is R388 which is driven via "diode-connected" transistor U380D. Transistor Q366 drives current mirror U370D and U370B. Diode CR370 ensures that the collector-base voltage of U370D is not too low, and CR369 compensates for U370C, to equalize the collector potentials of U370B and U370D. Q327 provides common-mode stabilization for transistors Q363 and Q365.

The collector current of U370C is the output of the current mirror and is equal to the collector current of Q366. Resistor R388 passes a current equal to the difference in the collectors of Q366 and Q367 (the trigger signal). Transistor U380C acts as an impedance buffer, whose voltage drop is compensated by U380D. The output from the emitter of U380C is the analog trigger signal. In X-Y mode U380B is biased off, allowing the trigger signal to be passed to the X-Y Amplifier (diagram 7). When HF REJECT is selected, U380E is switched off. This allows C372 to be switched in by U380A, thereby shunting signals of frequencies about 30 kHz and above to ground.

Peak Rectifiers

The analog trigger signal is passed to the positive and negative Peak Rectifier circuits. The Peak Rectifiers generate voltages equal to the positive and negative peaks of the analog trigger waveform in P-P AUTO and TV FIELD modes. In NORM and SGL SWP modes, the Peak Rectifier outputs assume a voltage of about the full peak-to-peak limits of the trigger signal.

The analog trigger signal is applied to the bases of U415B and U435A. In P-P AUTO, C418 charges to the positive peak of the analog trigger signal less the U415B base-emitter drop. The base-emitter drop of U415D compensates so that the output of U425B is equal to the positive peak of the analog trigger signal. In NORM Trigger MODE, the base drive to U415A rises to about +3 V, which drives the output of U425A to this level.

In P-P AUTO, C431 charges to the negative peak of the analog trigger signal, and Q435 will only switch on if the base drive to U435 is less than that of U435B. If Q435 switches on, then C431 will discharge to a more negative voltage so the output of U425A will track the negative peak of the analog trigger signal. In NORM mode, U415E switches on, and C431 charges to about -3 V via CR431. Trigger LEVEL control R426 (shown on diagram 10) selects a trigger level voltage between the peak rectifier outputs to give trigger operation over a sufficient dynamic range.

Coupling Circuit

The Trigger Amplifier is optimized for bandwidth, not dynamic range. A current is added to the summing stage of Q363 and Q365 (via R397 and R398) to shift the desired switching point on the analog trigger signal to the threshold of the Schmitt Trigger circuit (fixed at zero volts) shown on diagram 5. The selection of current drivers to feed the Trigger Amplifier is achieved by emitter switching of differential pairs U445C and U445D, U445A and U445B, and U435C and U435D. In NORMAL DC coupling, a fixed current proportional to the voltage on the LEVEL control is passed to the summing stage by U445C and U445D. This is enabled by the DC signal from U308A being HI to bias on Q420. The DC_TRIG(L) control signal is level-shifted by R1411-4 and R1416 before being fed to shift register U1406.

In NORMAL AC coupling, the dc component of the analog trigger signal is extracted by a low-pass filter circuit R470, C471, C472 and U415C. The dc component is added to the LEVEL voltage, and the result is fed into amplifier U450A. The output of U450A controls differential pair U435C and U435D and completes the feedback loop that adjusts the offset current so that the input of U450A is held at zero volts. This forces the dc component of the analog trigger signal to be equal and opposite to the LEVEL voltage, giving AC coupling with DC shift. LF REJECT operates in exactly the same way, except that the time constant of the low-pass filter is changed by switching off U415C, allowing C473 to dominate the circuit. P-P AUTO operates by establishing a feedback loop with U450B to hold the voltage on LEVEL at zero. Note that P-P AUTO does not distinguish between DC and AC coupling.

The PP_AUTO(L) control line is detected and level-shifted by R1410 and R1411-7 before being fed to U1406. The AC_TRIG(L) control line is level-shifted by R1411-6 and R1412 before being fed to shift register U1406. The LF_REJ(L) control line is level-shifted by R1411-5 and R1414 before being fed to shift register U1406.

Trigger Level Comparator

The Trigger Level Comparator shown on diagram 5, compares the level of trigger signals selected by the Trigger SOURCE switch to a zero voltage level. Positive-or negative-slope triggering is selected by the front-panel Trigger SLOPE switch.

The analog trigger signal drives the base of U460B. The transistors of U460 form a differential amplifier. With the input to U460E grounded, it is effectively a single-ended-to-differential amplifier. The cross-coupled collector outputs can reverse the direction of the signal fed to the succeeding stage depending on the selection by the SLOPE control.

Schmitt Trigger and TV Trigger Circuit

This circuitry generates a signal that drives the Trigger Logic as a function of the Trigger Level Comparator output signal and the Trigger MODE switches.

The output signals from the Trigger Level Comparator drive Q400 and Q401. These transistors are configured as a current mirror that converts the differential output to a single-ended current to drive amplifier U480C. Slope Balance potentiometer R481 corrects for dc offsets between positive and negative slopes. Shunt-feedback amplifier U480C converts a current input to voltage output to drive the input of the Schmitt Trigger, U480D, through R485. Positive feedback for the Schmitt Trigger is provided by Trigger Sensitivity potentiometer R489, and C489 reduces the trigger jitter by increasing positive feedback at higher frequencies. The setting of R489 determines the circuit hysteresis.

When TV FIELD is not selected, the TVF(L) signal connected to R487 is HI (unasserted). Transistors Q488 and Q489 are biased off, and a LO is placed on one input of U480A by R492–R493. This LO input will cause U480A to invert the output from U480D. With Q489 off, a LO will be placed on one input of U480B by R495, and U480B will also act as an inverter. The Trigger signal at the output of U480B is therefore the same as the input signal to U480A.

When TV FIELD is selected, the TVF(L) line is LO (asserted). The outputs of U480D will determine the conduction states of Q488 and Q489, and the input of U480A connected to R492 will be HI. The output of U480A will be LO, and U480B will invert the signal at its other input. Signals at the collector of Q489 are filtered by C495, R495 and C496 to reject TV Video information and average the TV horizontal-sync pulses. Setting the trigger-level threshold near the center of the horizontal-sync-pulse swing establishes the untriggered level. When the TV vertical-sync block occurs, the output of the filter applied to U480B pin 7 rises to a level that causes the Trigger output gate U480B pin 3 to switch. Precise TV field synchronization is obtained as a result of this filtering action. The Trigger signal output will be the inverse of the filtered signal appearing at U480B pin 7. The TVF(L) control line is fed to shift register U1406.

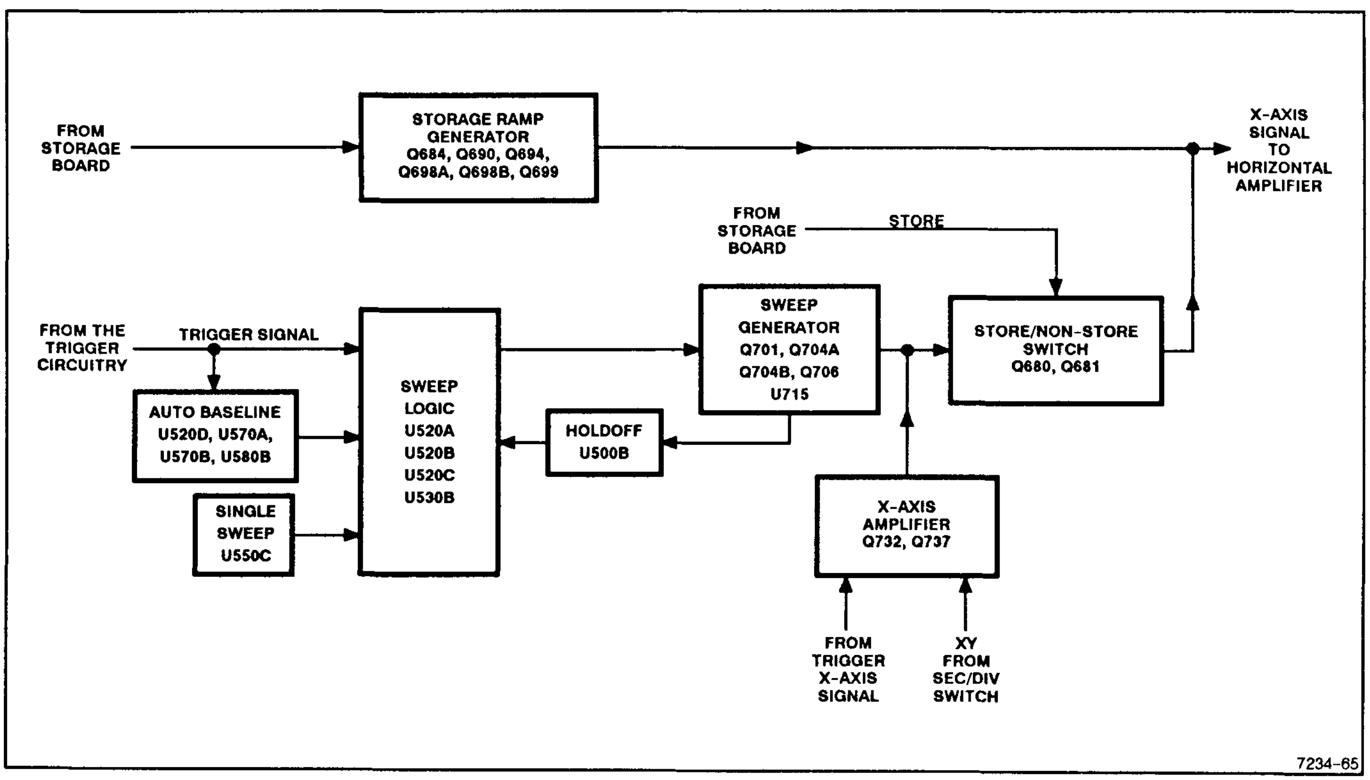


Figure 3-3. Block diagram of the Sweep Logic and Sweep Generator circuits.

SWEEP LOGIC (diagram 6)

Norm

When NORM trigger is selected, the circuit is ready to start the sweep in response to a trigger signal. Flip-flop U530B has a LO on the SET, RESET, and D inputs. A trigger pulse received at the CLOCK pin of U530B clocks the LO on the D input to the Q output and enables the sweep to start.

The output of the Sweep Generator is fed back via W701-4 into a potential divider formed by R501 and R502. This divider is arranged so that when the ramp voltage reaches approximately 12 V, U560E is turned on, producing a LO on the input of inverter U520A. The signal from U520B is inverted by U520C to give an overall OR function which is fed to the SET input of U530B. This overrides the CLOCK input and puts a HI on the Q output of U530B (pin 15), resetting the sweep.

The sweep reset is also fed to the input of Holdoff Timer U500B. This monostable multivibrator gives a holdoff time dependent upon the holdoff capacitor selected and the variable holdoff resistor chain. The holdoff pulse from the monostable multivibrator maintains the HI on the SET input of U530B until the end of the holdoff period. At that time the SET is driven LO, allowing the next trigger pulse to start the sweep.

P-P Auto

In the P-P AUTO mode, the sweep will free-run in the absence of a trigger signal. Should there be more than 50 ms between trigger pulses, the Auto Baseline Generator, consisting of U580B, U520D, U570A and U570B, will initiate a sweep. The circuit of U580B is a 20-Hz clock pulse generator. The 20-Hz clock signal is passed through Schmitt trigger U520D to provide a fast rise time. This is to ensure that flip-flops U570A and U570B switch at the same time.

With no trigger signal, the first clock pulse from U580B resets U570A, putting a HI on the D of U570B. This will then be clocked (giving a LO on TRIGGERED) when the next 50 ms pulse arrives. If the end of sweep has occurred and the holdoff period has elapsed, then the output of U520C will be LO. Because TRIGGERED and P-P_AUTO are both LO, the output of U550D will put a LO on one input of U550B. As the other input is also LO, the output of U550B will put a HI on the RESET pin of U530B. That resets the flip-flop, placing a HI on the base of Q536 that turns it off and forces GATE(L) LO at the collector of Q536 to initiate a sweep.

If a trigger occurs, the HI on the D pin of U570A is passed to the Q of U570A, to reset U570B, and put a HI on the TRIGGERED line. The output of U550B will then be LO, allowing U530B to respond to the next trigger signal. When the TRIGGERED line is HI the TRIG'D/READY light is turned on via U550A.

Single Sweep

When SGL SWP Trigger MODE is selected, the SINGLE SWEEP(L) line is LO, holding the D input of U570A LO. This effectively disables the Auto Baseline Generator and also puts a LO on the TRIGGERED line. At the end of a sweep, the holdoff pulse is latched by U530A via U520B and U550C, and the D input of U530B is driven HI. Thus the sweep will not start on receipt of a trigger. This condition is cleared by a pulse from single-shot monostable U500A that clocks the LO on the D input of U530A to the Q output, allowing the next trigger to initiate a sweep.

The Monostable circuit of U500A is used as a switch-debounce circuit. Timing components R506 and C506 are chosen to give a pulse width of about 30 ns, a pulse that is shorter than the fastest sweep speed. Monostable U500A also sets flip-flop U540A, turning the TRIG'D light on via the LED Driver circuit (U550A and U560A and B). When the holdoff period is initiated (and U500A has timed out), U500B will clock a LO back onto the Q output of U540A, allowing the TRIG'D light to be turned off.

In STORE Mode single sweep, the ENA_TRIG_SS(L) line (J1008-4) holds the sweep at start. The line disables the output of U520C by connecting its pulldown resistor HI, holding U530B set. The TRIG'D LED is also held extinguished via CR566. When the Storage Board receives a reset instruction from U500A, the pretrigger memory fills, PRE_FUL goes true, and the ENA_TRIG_SS(L) line releases U530B to enable triggers.

Alternate Channel Switching

The ALT_SYNC(L) signal is provided for the channel switching circuit so that when ALT Vertical MODE is selected, channel switching will be synchronized with the Time Base. The alternate switching pulse (ALT_SYNC(L) from U500 pin 9) is supplied at the end of each sweep to the Channel Switching Logic circuit.

Probe Adjust Generator

The Probe Adjust circuitry, shown on circuit diagram 6, is a square-wave generator and diode-switching network that produces a negative-going, square-wave signal at the PROBE ADJUST terminal, J590. Amplifier U580A forms a multivibrator that has an oscillation period set by the time constant of R587 and C587. When the output of the multivibrator is at the positive supply voltage, CR588 is forward biased. This reverse biases CR589, and the PROBE ADJUST signal is held at ground potential by R590. When the multivibrator output changes state and is at the negative supply voltage level, CR588 is reverse biased. Diode CR589 becomes forward biased, and the circuit output level drops to approximately -0. 5 V.

TIME BASE (diagram 7)

The Miller Sweep Generator and Storage Ramp Generator circuitry, shown on circuit diagram 6, produce linear voltage ramps that drive the X-Axis Amplifier for the NON-STORE and STORE sweeps respectively.

Miller Sweep Generator

The Miller Sweep Generator (see Figure 3-3) produces a linear voltage ramp that drives the Horizontal Amplifier. It produces the ramp voltage by maintaining a constant current through timing capacitors, causing a linear voltage rise across them as they charge.

Field-effect transistors Q704A and Q704B are matched devices with Q704B acting as the current source for Q704A. Since the gate and source of Q704B are connected together, the source current available to Q704A is just enough so that there is no voltage drop across the gate-source junction of Q704A.

When the sweep is not running, Q701 is biased on, holding the selected timing capacitors in a discharged state. The low impedance of Q701 in the feedback path holds the Miller Sweep output near ground potential. The voltage across Q701, in addition to the base-emitter voltage of Q706, prevents Q706 from becoming saturated.

The sweep ramp is initiated when Q536 (diagram 6) is biased off. The GATE(L) signal going to the base of Q701 from the Sweep Logic circuit turns Q701 off. The timing capacitors then begin charging at a rate set by timing resistors R701, R702, and the position of the SEC/DIV switch, S701. Timing resistor R677 is used when external clock is selected in STORE mode. One end of timing resistor R701 is connected to the wiper of R721, and the other end is connected to the input of the Miller Sweep Generator. Due to feedback from the circuit output through the timing capacitors, the integrator input voltage at the gate of Q704A remains fixed and sets a constant voltage across the timing resistors. This constant voltage produces a constant charging current through the timing capacitors, which results in a linearly increasing voltage ramp at the output of the Miller Sweep Generator circuit. Each position of SEC/DIV switch S701 is uniquely decoded and fed to shift register U1404.

The sweep signal is applied through gain-setting resistor R740 to the emitter of Q681. The collector current of common-base stage Q681 drives the X1/X5 Preamplifier in the Horizontal Preamplifier (diagram 8).

When the ramp reaches approximately 12 V, the Sweep Logic circuitry will initiate the holdoff period. During holdoff, Q701 is turned on, and the Miller Sweep is reset. This holdoff period is necessary so that the timing capacitors can be fully discharged before another sweep starts. Capacitors C704 and C703 are always in the charging circuit and are used for high sweep speeds. Capacitors C701 and C702 are used for medium sweep speeds; C701 alone is used for slow sweep speeds.

Voltage Reference

The SEC/DIV Variable circuitry utilizes an operational amplifier to maintain a constant reference voltage at one end of R721 independent of the circuit load. The voltage applied to the timing resistors varies with the setting of R721, the SEC/DIV Variable control. A fixed dc voltage applied to the noninverting input of the operational amplifier, and feedback resistors R717 and R718 establish double that voltage at the anode of VR719. Resistor R722 is used to adjust the reference voltage when in 0. 5 ms to 10 μs SEC/DIV ranges to correct for mismatch between timing capacitors C701 and C702. The calibrated position of the SEC/DIV switch is detected and fed to shift register U1400.

Storage Ramp Generator

In STORE, the Storage Ramp Generator comprising Q694, Q690, Q684, Q698A and B, and Q699 is switched on in addition to the NON-STORE Miller Sweep Generator. The Miller Sweep continues to run to maintain correct operation of the holdoff control and trigger selection, but the sweep output is disconnected from the Horizontal Amplifier by a transistor, Q680, that shunts the sweep output to ground.

The Storage Ramp Generator operates the same as the NON-STORE sweep generator but with a fixed sweep time of 4ms. Transistor Q684 is turned off by DWELL(L) while the trigger point is displayed so that the electron beam dwells a little to increase the brightness at that point. The same action occurs at the point where a "time cursor" crosses the trace in STORE mode. The network comprising CR686, R655 and R686 ensures that the charging current is zero during a dwell. The GATE_STORE line resets the sweep as required and also switches it off in NON-STORE so that the NON-STORE sweep is not affected.

X-Y Amplifier

The X-Y Amplifier amplifies the CH 1 signal (X-AXIS) from the Internal Trigger circuitry (diagram 4) and passes it to the Horizontal Amplifier.

The EXT_CK_EN(L) line (W1009-5) is sent to the STORE switch and returns to three locations on the host instrument as XY(L). The switch disables XY in STORE by connecting the XY(L) line. In XY STORE mode, the XY(L) line is pulled LO via the EXT_CK_EN(L) line by a switch contact on S701 (the SEC/DIV switch). This LO biases Q732 on in the linear region. The circuit of Q732 and Q737 is a transconductance amplifier that changes an input voltage to output current. The input signal is applied through X-Gain adjust potentiometer R395 (diagram 4). The X-Axis offset adjustment is R736 (X-Centering). The signal current out of Q737 is fed into the Horizontal Amplifier (diagram 8).

The sweep is held at a constant low output level when in X-Y mode. When in the sweep mode, the XY(L) line is HI, and Q732 is biased off. This in turn biases Q737 off and disables the X-Y Amplifier.

The XY(L) line also turns U380B on (circuit diagram 4), thereby not allowing the X-AXIS signal to get to the X-Y Amplifier.

HORIZONTAL AMPLIFIER (diagrams 8 and 9)

The Horizontal Amplifier circuit drives the horizontal deflection plates of the crt. Signals to be amplified may come from the Miller sweep Generator in NON-STORE, from the Storage Ramp Generator in STORE, from the X-Y Amplifier in X-Y display mode, or from the cursor/readout system as crt readout information. See Figure 3-4 for a block diagram of the Horizontal Amplifier.

The X1, X10, X50 Magnifier circuitry and the horizontal portion of the Beam Find circuitry are also part of the Horizontal Amplifier circuitry.

Horizontal Signal Input

Horizontal Signal input current is applied to a shunt feedback stage consisting of U745A, U745B, R741, R742, R743, R744, and R745 (diagram 8). Resistors R741 and R742 set the gain of the stage. Horizontal positioning offset current is added at the input of U745A. The output of the shunt feedback stage drives the preamplifiers in all horizontal modes. The network consisting of R711, R712, R713, R714 and C714 improves the power supply noise rejection.

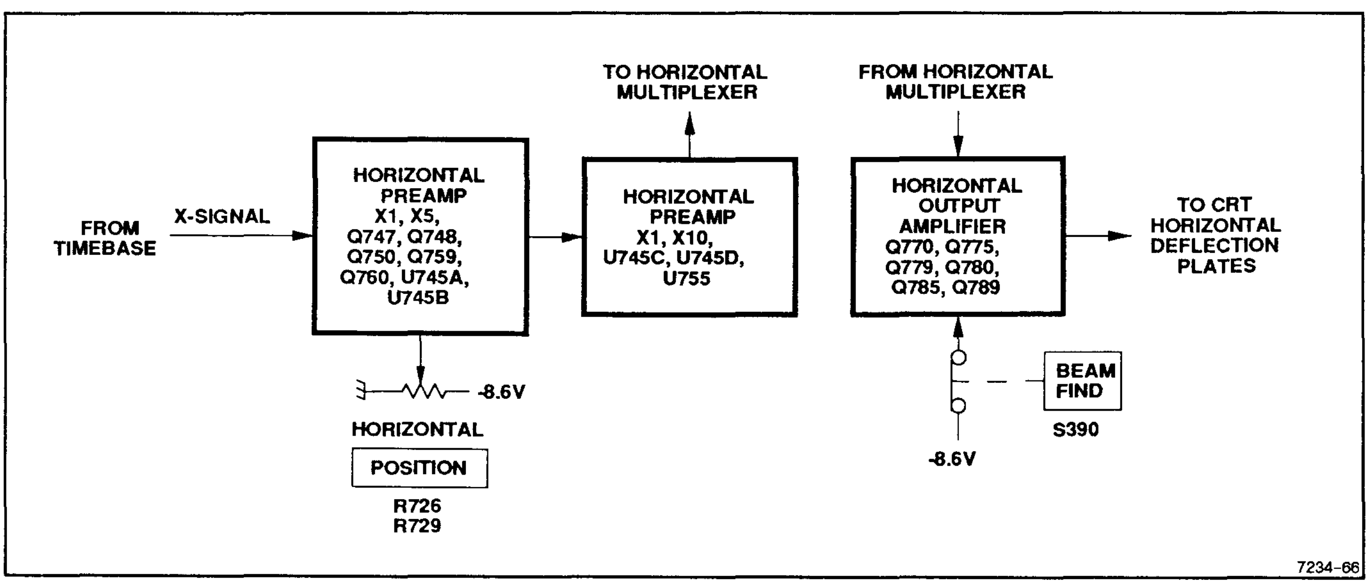


Figure 3-4. Block diagram of the Horizontal Amplifier circuit.

X1/X5 MAG Horizontal Preamplifier

The X1/X5 Preamplifier is a differential stage consisting of Q747, Q748, and associated components. When the X5 MAG line is LO, the X1 gain is set by resistor network R753 and R775 (X1 Gain), with current supplied through Q750. When X5 MAG is selected (HI), Q750 is switched off, and current is supplied through R730. Potentiometer R730 (X5 MAG Reg) is adjusted to balance the current through Q747 and Q748. The X5 gain is set by R753, R755, R731 and R749. When in X1 mode, CR747 and CR748 are reverse biased so that the X5 stage has no effect.

The collector outputs of Q747 and Q748 are applied to emitter followers Q759 and Q760 respectively. These two transistors provide impedance matching and drive signal to the X1/X10 MAG Preamplifier inputs.

The X5_MAG control signal is detected and level-shifted before being fed to shift register U1400.

X1/X10 MAG Horizontal Preamplifier

The X1/X10 amplifier is a differential amplifier consisting of U745, U755 and associated components. Signals from the X1/X5 preamplifier are buffered by emitter followers Q759 and Q760 before being applied to the bases of U745C and U745D. When the X10 MAG line is LO (X1 selected), U755B and U755C are biased off and U755A and U755D are biased on. Diodes CR773 and CR774 are reverse biased. The gain will then be set by R763.

When X10_MAG is HI, U755B, U755C, CR773, and CR774 are biased on, and U755A and U755D are biased off by U755E. The gain of the X10 stage is set by R763, R767, and R777 (X10 MAG Gain). Potentiometer R782 (X10 MAG Reg) balances the currents in the preamplifier so that there is no horizontal trace shift when switching between X1 and X10 modes. CR761 and CR762 limit the output signal swing of the amplifier to the horizontal multiplexer.

The X10_MAG control signal is detected and level-shifted before being fed to shift register U1400.

Horizontal Output Amplifier

The Horizontal Output Amplifier (diagram 9) provides final amplification of the horizontal signal to drive the horizontal crt deflection plates.

Signals from the horizontal multiplexer drive two shunt-feedback amplifiers. Due to the feedback, the input impedance of these amplifiers is low. The base voltages of Q770 and Q780 are biased at nearly the same dc level by the forward-biased diodes (CR781 and CR791) located between the two emitters.

Transistors Q770, Q775, and Q779 form a cascode-feedback amplifier for driving the right crt horizontal deflection plate. Amplifier gain is set by R784, with C784 providing high-frequency compensation. For low-speed signals, Q779 serves as a current source for Q775. At high sweep rates, the deflection signal is coupled through C785 to the emitter of Q779 to provide added pull-up output current to drive the crt. The amplifier formed by Q780, Q785, and Q789 drives the left crt horizontal deflection plate in the same manner as described above, with zener diode VR792 shifting the collector signal level of Q780 to the correct level to drive the emitter of Q785.

Horizontal Beam Find

The BEAM FIND switch (diagram 10) is buffered by emitter follower Q776. Diodes CR780 and CR790 are normally reverse biased by R776 when BEAM FIND is off. When BEAM FIND is active, Q776 is turned on, and its emitter is driven negative to about -8 V. The voltage on the cathode of VR776 drops to about 5 V, causing CR780 and CR790 to be forward biased. Current through CR780 and CR790 causes the output common-mode voltage of the two shunt-feedback amplifiers to be shifted negative to reduce the available voltage swing at the crt plates. This stops the trace from being deflected off-screen horizontally.

FRONT PANEL CONTROLS (diagram 10)

The Front Panel controls diagram shows the complete Front Panel circuitry to aid in servicing that circuit board. The active circuitry on the Front Panel includes the External Trigger Buffer Amplifier, Q370B and Q370A, and the Horizontal Position Control current source, Q725. Operation of the FET External Trigger Buffer Amplifier is similar to the CH 1 and CH 2 Source Followers described previously.

All mode switching for the Vertical, Horizontal, and Trigger circuitry is done by the Front Panel switches.

POWER SUPPLY (diagram 11)

The Power Supply circuitry converts the ac-power-line voltage into all the voltages required by the instrument.

It comprises the Mains Input Board, Transformer, Preregulator, Series Pass, and Inverter circuits.

Mains Input Board

The power switch (S901)connects the ac-power line to the primary winding of the toroidal wound input transformer, T901, via fuse F901, filter components L901, L902, C903, C904, C905, and the VOLTAGE SELECTOR switch S902. The secondary output is rectified and smoothed by CR901, CR902, CR903, CR904, and CR900. With an ac-input voltage of 240 V, there is approximately 60 V between W903-1 and W903-2 at full load.

LINE SYNC. The additional components on the Mains Input Board produce a Line Sync signal for the Trigger circuit. Transistor Q900 is a floating differential amplifier with a dc bias network comprising R905, R904, and R902. Resistors R906 and R903 apply a small line-frequency signal from the secondary of T901 to the base-emitter junction of Q900. The resultant collector current of Q900 is a line-frequency, sine-wave signal that is fed via W903-3 to the Main Board.

Preregulator

The 60-V power supply from the Mains Input Board, is applied to the Preregulator circuit formed by U910, Q913, and associated components. Zener diode VR910 and R910 reduce the incoming supply for preregulator U910. The Preregulator oscillates at a nominal 39 kHz, as determined by timing components C908 and R908. The square-wave output is level-shifted by Q911, and fed to the Darlington pair circuit formed by Q912 and power transistor Q913. When Q913 is conducting, current ramps up through L910. When Q913 is off, the current ramps down while flowing in through the flywheel diode, CR912. Preregulator U910 varies the duty cycle of conduction of Q913, so that the voltage on filter capacitor C914 is a nominal 39. 5 V. The network of R917, R922, R932, R934, and CR915 monitors the voltage across Q923;and, if that voltage is lower than the nominal 1. 4 V, U910 increases the voltage across C914 until Q923 has the correct voltage.

If Q923 is open circuited, CR915 clamps the lower supply voltage to 31 V. The ratio of R932 and R922 across R934 together with R917 is chosen so that if Q923 is short circuited, the maximum voltage across C914 is 41 V. Thus the Preregulator supplies a sensible output under all conditions of the circuitry that it drives except during an overload condition. In this case, the voltage developed across the current-sense resistor (R907) reaches the offset voltage developed by R910 and R911, and U910 current limits the output.

Series Pass

The function of the Series Pass transistor Q923 is to reject ripple current having a frequency of twice the power-line frequency. The nominal dc voltage across it is only 1.4 V. Base current is supplied to Q923 via R923, CR923 and CR924 in the absence of drive from Q921 when the instrument is first switched on. Transistor Q923 is driven by both halves of U920 through Q921. The output at pin 7 of U920 serves to reject hum on the 38V supply by comparing the output of potential divider R930 and R929 with the voltage across reference diode VR931. The output at pin 1 of U920, slightly varies the value of the reference as seen at pin 6 via attenuator resistors R925 and R926. This variation maintains the -8.6 V supply at the value set by the -8.6 V Set potentiometer, R933.

Inverter

Inverter oscillator U940 is driven, via Q918 and R946, at the same frequency as U910. The outputs of U940 are two non-overlapping complimentary square-wave signals to Q930 and Q960. These transistors are in feedback loops, one of which is formed by the filter R953, CR953, reservoir capacitor C953, and level shifter VR939. The feedback is such that the base of Q940 is adjusted to drive Q950 sufficiently hard that the emitter swings to within 3 V of ground, but not hard enough to saturate it. The output voltages of transformer T902 secondary windings are full-wave rectified. The 100 V supply voltage is derived from an auto-transformer winding in series with the primary winding. Resistors R942 and R941 feed a sample of the 38 V supply voltage into the error amplifier connected to pins 1 and 2 of U940. If the 38 V supply should go high, U940 will shut down.

Dc Outputs

The low-voltage power supply circuitry on the secondary windings of T902 consists of rectifier and filter components only. All the regulation is done by the Preregulator and Inverter Control circuitry in the primary side of the transformer. Both half-wave and full-wave rectifiers are used, and either simple capacitor or capacitive-input pi-filter circuits are used. Rectifier and filter type used for each of the secondary supplies depends on the load requirements.

Separate windings on the transformer supply the cathode voltage to the crt and the ac-drive voltage to the

Grid Bias DC Restorer. Drive voltage to the fan motor is obtained from between the -5.1 V and +5.1 V supplies.

Jumpers are placed in each of the power supply output lines. In the event that troubleshooting is needed for a circuit loading problem, these jumpers may be lifted to isolate the power supply from the other circuitry of the oscilloscope.

Z-AXIS AND CRT (diagram 12)

Current Summing

The Z-Mod Amplifier controls the crt intensity via several signal sources that vary the intensity or completely blank the screen. There are two intensity control circuits. One controls the intensity for NON-STORE traces, the other controls the intensity of the STORE traces and crt READOUT display.

The trace intensity depends on the current flowing into the summing node at the junction of CR827, R841, and R832. The value of this current is determined by the values of the resistors R806, R818, R820, R821, and the voltage on Q804 emitter, which is controlled by the NON-STORE intensity control, and the voltage on Q803 emitter, which is controlled by the STORE/READOUT intensity control.

The current is steered by a pair of diodes, which either pass it to the summing node or divert it. For example, CR819 and CR820 are associated with R820. If XY(L) is LO then CR820 conducts, supplying the summing node with the current necessary for a display in XY mode. If XY(L) is HI, this current flows instead through CR819.

In NON-STORE, the signal VDAC_EN is LO and COMP_Z(L) is HI, thus CR823 is not conducting and CR821 is allowed to pass current through R821 to turn the beam on during sweep (when GATE(L) signal is LO) provided that the CHOP BLANK signal is also LO (the beam is not switching between channels). If this signal is HI, CR822 will conduct, and divert the current which flows through R821. Since COMP_Z(L) is HI, CR817 is conducting and passes the current from R818, thus disabling the STORE/READOUT intensity circuit.

At SEC/DIV settings of 0. 2 ms and higher, the signal FAST_NS_Z(L) is LO and current from R806 is also allowed to flow into the summing junction. At SEC/DIV settings of 0. 5ms and lower, the signal FAST_NS_Z(L) goes HI and current from R806 now flows through CR805 and CR806, thus slightly reducing the beam intensity.

In XY mode GATE(L) is HI and CR816 conducts to pass the current from R821. Since XY(L) is LO, current now flows through R820 to the summing junction.

In STORE or when READOUT is to be displayed, VDAC_EN goes HI thus disabling the NON-STORE intensity circuit. COMP_Z(L) is LO and CR818 is allowed to pass current from R818 to the summing junction.

In the horizontal magnified modes of both NON-STORE and STORE, transistors Q801 and Q802 switch on and the emitters of transistors Q803 and Q804 are taken a little lower to increase the current flowing into the summing junction. This has the effect of increasing the beam intensity. When cursors or readout information is to be displayed, CR_YDAC_EN goes HI which switches Q805 and Q801 off, thus returning the current flowing into the summing junction back to its original value.

U1407B is configured as a schmitt trigger which detects the counterclockwise position of the STORE/READOUT control. The output is level shifted and fed to shift register U1406.

Z-Axis Beam Find

The beam intensity can also be modified by pressing the BEAM FIND button. This causes the BEAM FIND line to go to about -8 V. The resulting 1 mA current through R819 overrides any other current combinations to ensure a visible trace.

In NON-STORE, the application of an external Z-Mod voltage from the front panel input connector, will vary the current through R823 and R824 and therefore the intensity. In STORE or when READOUT is to be displayed, VDAC_EN switches Q825 on and shunts this current to ground.

Z-Mod Amplifier

The current from the sources described above is added together and fed through the level-shifting diodes, CR827 and CR828, into the virtual earth of shunt-feedback amplifier Q835, Q840 and Q845. Feedback resistor R841 sets the transresistance gain for changing the input current to a proportional output voltage. Emitter follower Q835 is dc coupled to Q840 and, for low-speed signals, Q845 acts as a current source.

Fast transitions couple through C845; intermediate transitions couple through R846 and C846, providing added current gain through Q845 for fast voltage swings at the output of the amplifier.

Grid Bias DC Restorer and Multiplier

The Grid Bias DC Restorer circuit sets the crt control-grid bias and couples the ac and dc components of the Z-Mod Amplifier output to the crt control grid. Direct coupling of the Z-Axis Amplifier output to the crt control grid is not employed due to the high potential differences involved. Refer to Figure 3-5 during the following discussion.

Ac drive to the Grid Bias DC Restorer circuit is obtained from pin 4 of T902. The drive voltage has an ac peak amplitude of about 100 V at a frequency of about 20 kHz, and it is coupled into the DC Restorer circuit through C853 and R853. The cathode of CR851 is biased by the wiper voltage of Grid Bias potentiometer R851, and the ac-drive voltage is clamped whenever the positive peaks reach a level that forward biases CR851.

The Z-Mod Amplifier output voltage, varying with display intensity between +3 V and +75 V, is applied to the Grid Bias DC Restorer at the anode of CR853. The ac-drive voltage holds CR853 reverse biased until the voltage falls below the Z-Mod Amplifier output voltage level. At that point, CR853 becomes forward biased and clamps the junction of CR851, CR853, and R854 to the Z-Mod output level. Thus, the ac-drive voltage is clamped at two levels to produce a square-wave signal with a positive dc-offset level.

The Grid Bias DC Restorer is referenced to the -1.8 kV crt cathode voltage through R858 and CR854. Initially, both C855 and C854 charge up to a level determined by the difference between the Z-Mod output voltage and the crt cathode voltage. Capacitor C855 charges from the Z-Mod output through R858, CR854, and CR855 to the crt cathode. Capacitor C854 charges through R858, CR854, R854, and CR853 to the crt cathode.

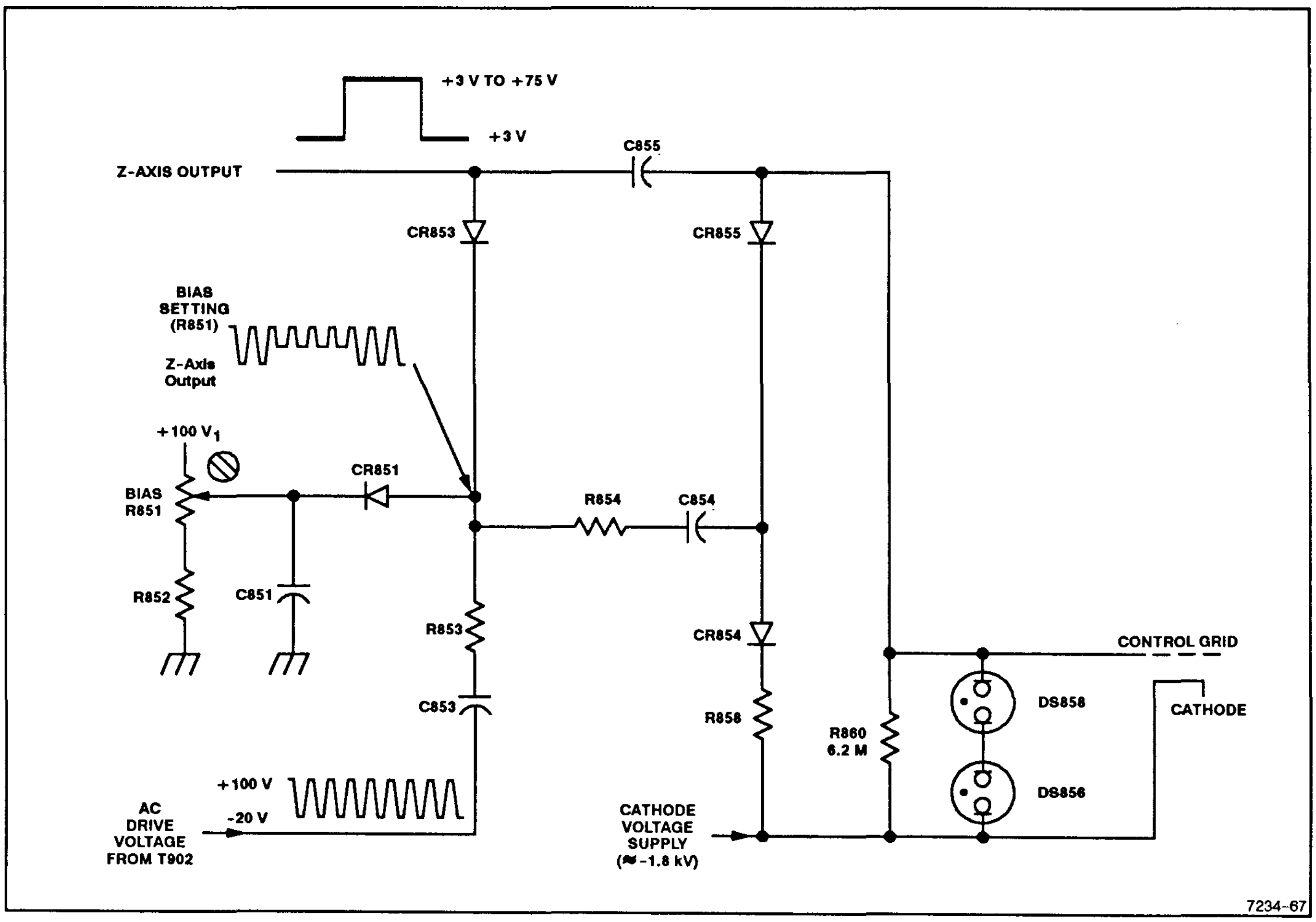


Figure 3-5. Simplified diagram of the Grid Bias DC Restorer circuitry.

During the positive transitions of the ac drive, from the lower clamped level toward the higher clamped level, the charge on C854 increases due to the rising voltage. The voltage increase across C854 is equal to the amplitude of the positive transition. The negative transition is coupled through C754 to reverse bias CR854 and to forward bias CR855. The increased charge of C854 is then transferred to C855 as C854 discharges toward the Z-Axis output level. Successive cycles of the ac input to the DC Restorer charge C855 to a voltage equal to the initial level plus the amplitude of the clamped square-wave input.

The added charge held by C855 sets the control-grid bias voltage. If more charge is added to that already present on C855, the control grid becomes more negative, and less crt writing-beam current flows. Conversely, if less charge is added, the control-grid voltage level becomes closer to the cathode-voltage level, and more crt writing-beam current flows.

During periods that C854 is charging, the crt control-grid voltage is held constant by the long time-constant discharge path of C855 through R860.

Fast-rise and fast-fall transitions of the Z-Mod output signal are coupled to the crt control grid through C855 to start the crt writing-beam current toward the new intensity level. The Grid Bias DC Restorer output level then follows the Z-Mod output-voltage level to set the new bias voltage for the crt control grid.

Neon lamps DS858 and DS856 protect the crt from excessive grid-to-cathode voltage if the potential on either the control grid of the cathode is lost for any reason.

HV Multiplier

High-voltage multiplier U875 uses the 2 kV winding of T902 to generate 10. 8 kV to drive the crt anode. An internal half-wave rectifier diode in the multiplier produces -1.8 kV for the crt cathode. The -1.8 kV supply is filtered by a low-pass filter formed by C975, C976, R976, R978, and C979. Neon lamp DS870 protects against excessive voltage between the crt heater and crt cathode by conducting if the voltage difference exceeds approximately 75 V.

Focus Supply

Focus voltage is also developed from the -1.8 kV supply by a voltage divider formed by R894, R892, FOCUS potentiometer R893, R891, R890, R889, R888 and R886.

STORAGE SYSTEM (diagram 29)

The Storage system is divided into subsections. Diagram 10 shows the interconnections between the storage subsections and should be used as an aid in signal tracing between the Storage Board subsystem schematic diagrams. These subsections are:

Vertical Interface (diagram 16),
Acquisition System (diagram 30),
Display System (diagram 31),
Clock and Time Base (diagram 25), and
Power Reset, and Storage Switches (diagram 26).

NOTE

The signal names in the Storage Board portion of the circuit description are indicated differently than in the analog circuitry portion of the circuit description to match schematic labeling. The space between parts of the signal name are filled with an underscore, and signals that are asserted LO are indicated by the parenthesis L "(L)" following the signal name.

VERTICAL INTERFACE (diagram 16)

Signal Acquisition

Channel 2 acquisition signals are applied to common base transistors Q1013 and Q1014 via CR1013, R1038 , CR1014 and R1039. The gain of this stage is set by R1003 and R1004 which adjust the signal current that is shunted between the differential inputs. Resistors R1031 and R1033 set the dc bias for common base transistors Q1013 and Q1014; Q1002 and Q1001 being the active loads for the previous stage. The signal current is then converted to a voltage in the shunt-feedback stage consisting of Q1005, Q1006, R1005, R1018 and R1027. Resistors R1024 and R1021 fix the dc bias for Q1005.

Resistors R1019 and R1017 sets the dc null-offset at the output (ADC2). Frequency compensation is provided by C1004 and R1026. Diodes CR1007, CR1008, CR1009 and CR1010 clamp the output voltage swing to approximately + or -1. 5 volts to protect the A/D converter input.

The operation of channel 1 is identical to that of channel 2.

In ADD Vertical MODE, channel 2 is disabled by biasing off Q1013 and Q1014. Transistors Q1011 and Q1012 are biased on. The collector currents are summed with CH 1 (Q1007/Q1008) collector currents into Q1010 and

Q1009. The channel 2 ADD gain is set by R1040 and R1041; the ADD null-offset is set by R1036. The output signals (ADC1 and ADC2) are applied to the analog-to-Digital Converters, U1103 and U1104 for digitizing.

A/D Converters

Digitizing of the input signals is done by the analog-to-Digital Converters U1103 and U1104. Each channel has its own converter. The A/D converters used are high speed flash converters producing an 8-bit digital word which represents the magnitude of the analog input signal (pin 14). Conversion takes place on the falling edge of A/D clock (CONV_CLK). The range of the analog input signal is +1 V to −1 V, producing byte values of 11111111 to 00000000 respectively. Conversions are continuously taking place at the CONV_CLK rate. When the fastest range available in STORE mode (20 μs/div) is selected, the clock runs at 20 MHz. On all other SEC/DIV switch settings, the A/D clock runs at 8 MHz.

Reference Voltage

The reference chain is driven by a stable +1V and −1V (applied to pins 24 and 23 respectively) voltage source. A 5 V regulator, U1101, supplies an input of 5 volts to the inverting operational amplifier U1102A. Resistors R1102 and R1106 set the gain, giving an output of −1 V at the emitter of Q1102. Transistor Q1102 provides the current necessary to drive the reference chain.

The +1 V is generated in a similar fashion by unity-gain inverting amplifier U1102B. The gain is set by the resistors R1104 and R1105 with Q1101 providing the current source requirements. Capacitors C1106 and C1107 limit the bandwidth of the amplifiers for stability.

ACQUISITION SYSTEM (diagram 30)

The acquisition system is divided into two main areas, the Acquisition Data Path (diagram 20) and the Acquisition Control Section (diagram 18).

The main parts of the Acquisition Data Path consist of the Channel Data Latches, the Acquisition RAM, CH 1 and CH 2 Display Buffers, and the Status Latches (diagram 20).

The Acquisition Control section consists of the Record State Machine, Roll State Machine, the Timing Generator, and Trigger Control Logic (all on diagram 18).

ACQUISITION DATA PATH (diagram 20)

Output data from the Channel A/D Converters (diagram 17) is latched into Data Latches U1504 and U1505 at the SAV_CLK(L) rate. That rate is determined by the position of the SEC/DIV switch. The output enables for these two normally enabled latches are controlled by the C1/C2_XFER(L) transfer signals generated by the Display Controller (diagram 23). The Data Latches are disabled during a transfer of data to the Display system so as not to cause a bus contention with the Acquisition RAM.

The 12 address lines (ARA0-ARA11) of the two Acquisition RAM (U1506 and U1507) are driven by the Address Counter, which is itself clocked by REC_CLK. Data bytes from the channel latches are written into the RAM by WR_CLK(L). In RECORD mode, the WR_CLK(L) and REC_CLK signals are both at the same rate as SAV_CLK(L). For each SAV_CLK(L), a new address is generated for the next acquisition.

Signals from both channels are acquired simultaneously, but the transfer of data to the Display System is sequential. During the transfer of data, the relevant display buffer and corresponding RAM is enabled with the corresponding data latch being disabled. For example, for a CH 1 data transfer, CH 1 DATA LAtch U1504 is disabled, and CH 1 Acquisition RAM U1506 and CH 1 Display Buffer U1508 are enabled. The CH 1 data is then written into Waveform RAM U2006 (diagram 24). The Address Counter is then clocked at the display rate of 1 MHz until the transfer is complete.

Just prior to an acquisition in single-sweep ROLL mode, the output enables of the data latches are disabled by U1524 and U3006B. At that time, the RAM is preset to a known value by pull-up resistors RP1502 and RP1503. When the Roll State Machine receives an SS_RST signal, it asserts AC_CLR. The rising edge of the AC_CLR signal clocks U3006B pin 8 LO and inhibits U1524A and U1524B. This places the channel data latch outputs into a high impedance state and allows the RAM data lines to be tied to a defined value. The next occurrence of AA_CLK clears this condition by setting the output of U3006B (pin 8) HI.

Status Latches

The components associated with the Acquisition Status Latch (diagram 20) are U1502C, U1503, U1765A, U2253D and U3204A and D. During an acquisition, the current status of the host instrument is latched into U1503. The latch is clocked from a dual 4-to-2-line multiplexer. In RECORD mode, the source of the latching signal is TRIG_D from the trigger synchronizer circuit. In ROLL mode, the source of the signal depends on whether the instrument is in single-sweep or untriggered ROLL. For single-sweep mode, INIT is used. In untriggered ROLL, as there is no trigger and the display is continuous, the signal 4K_TC from the display counter latches the status.

The other output of the multiplexer is the waveform status update signal (WS_UPDT). This signal latches the status of the last acquisition into the waveform status latch for the Display system. In RECORD mode, the source of this signal is WS_CLK(L) from the Display Controller. In ROLL mode the source is either INIT or 4K_TC. Components U3204A and U3204D generate the ADD and ADD(L) signals from the channel status input signals. These signals are used to switch in the ADD circuitry in the Vertical Interface circuit.

ACQUISITION COUNTERS AND ROLL REGISTERS (diagram 22)

Address and Record Counters

The Address Counter consists of U1509, U1510, U1511, U1522 and diodes CR1503 and CR1504. The three high-speed, modulo-16 counters U1511, U1510 and U1509 are connected as a multistage counter with look-ahead carry.

At the start of an acquisition, the counters are first enabled by AC_ENA and then parallel-loaded with the their respective initial-load values by asserting AC_LOAD(L) and clocking the counters via the REC_CLK line. The outputs of the counters are the Acquisition RAM address bus. During an acquisition, the counter is clocked by REC_CLK, and when the counter reaches terminal count diodes, CR1503 and CR1504 become reverse biased. On the next rising edge of the 20 MHz(L) clock the output PRE_FUL is asserted.

The Record Counter consists of U1512, U1513, U1514, U1522 and diodes CR1501 and CR1502. Operation is similar to the Address Counter but uses RC_ENA and RC_LOAD(L). The corresponding output is EOR (end-of-record). During a RECORD mode acquisition, the Record Counter is enabled after a valid trigger has occurred. The EOR signal is then used to terminate the acquisition.

Initial Load Circuit

The components associated with initial loading of the Record and Address Counters are U1515 and resistors RP1500 and RP1501. At the start of an acquisition, the INIT line is asserted to place the initial-load values for the Address and Record Counters on the parallel-load bus. The value that is loaded will depend on whether the user has selected 25% or 75% pretrigger. This selection is reflected in the logic level of the Short Pretrigger line (SPT); it is HI for 25% and LO for 75%. If SPT is HI then the output of U1515A will be driven LO, taking PLV12 to the same state. If PLV12 is driven LO then PLV11 goes HI due to the action of U1515C. The PLV12 and PLV11 states are then complements of each other during initialization and are used as inputs for the most significant bit of the Record and Address Counters respectively.

Roll Registers

The Roll Registers are the Display Address Register (U1516 and U1517) and the Acquisition Address Register (U1518 and U1519). Registers U1516 and U1517 are used to store the 12-bit display address, and registers U1518 and U1519 store the 12-bit acquisition address.

In ROLL mode, the waveform data is displayed directly from the Acquisition RAM. When the Roll State Machine needs to store a new data sample, it saves the current display address by latching the state of the address bus with DA_CLK. The acquisition address is obtained by asserting an output enable (AA_OE) after first unasserting the display address outputs with DA_OE. After loading the new address into the Address Counter and storing the data sample, the Address Counter is incremented, and the next acquisition address is latched into U1518 and U1519 by asserting AA_CLK. The display address is then placed on the parallel-load value (PLV) bus and loaded into the Address Counter to resume the display process.

ACQUISITION CONTROL (diagram 18)

Data Acquisition

The acquisition of data is controlled by two state machines. The Record State Machine consists of U1753 and U1754; the Roll State Machine is formed by U1761, U1762 and U1763.

The other parts of the control section are the Timing Generator and Trigger Control and Synchronizer circuits. The Timing Generator selects the correct signals for clocking the Address and Record Counters and for generating the WR_CLK for the acquisition RAM. The Trigger circuits ensure that the trigger signal from the analog circuitry is properly selected and synchronized to the master clock used on the Storage board.

Record State Machine

The Record State Machine has a total of 11 inputs and 13 active outputs. The state of the outputs is purely a function of the current state of the machine. The state machine is clocked by the 20 MHz system clock. The operation of the state machine will now be described for a typical RECORD-mode acquisition. See Figure 3-6 for the Record Mode flow diagram.

After power up or the completion of a transfer of data to the display system, the Record State Machine is initialized. During initialization, the Address and Record Counters are loaded up with their respective pretrigger values. INIT activates the Initial-Load circuit to apply the correct 25% or 75% load value to the counters.

After the initialization sequence, the Record State Machine detects if the next acquisition is to be a ROLL Mode Acquisition by the logic level of the ROLL_S input. If this input is asserted, the Roll State Machine will be activated as described later. If ROLL_S is not asserted, the Record State Machine controls the acquisition of data by first asserting ACQ_ENA. The logical state of this line controls the generation of SAV_CLK(L) from the Time Base circuit and is used by the Timing Generator to generate both REC_CLK and WR_CLK(L). These two signals are used to clock the Address Counter and write data into the Acquisition RAM, respectively.

When sufficient data has been acquired to satisfy the pretrigger requirements, indicated by PRE_FUL being asserted, the Record State Machine enables triggers by asserting TRIG_ENA. This signal enables the Trigger Synchronizer, and on the occurrence of the next valid trigger, the TRIG_D input of the state machine gets asserted. When this happens the state machine enables the Record Counter by asserting RC_ENA.

The Address and Record Counters are both clocked by REC_CLK until the Record Counter reaches terminal count and EOR becomes asserted. The state machine then unasserts ACQ_ENA to inhibit any further SAV_CLK(L) pulses and terminate the current acquisition. The Address Counter then gets incremented by one count, effectively setting the counter to the start address of the newly acquired data.

In order to transfer the data to the display system, the XFER_PEND line is asserted, and no further action takes place until the display system responds by asserting the XFER_ENA line.

The occurrence of the XFER_ENA signal from the display system causes the state machine to select the DISP_CLK input to the Timing Generator and also enables the Address Counter. The Address Counter now gets clocked at a 1-MHz rate by the display system starting at its current address, the first data sample of the new acquisition.

When the complete set of data has been transferred for both channels, the Display system responds by asserting ACQ_RST. The ACQ_RST signal causes the state machine to unassert XFER_PEND and DISP_CLK_ENA and inhibits clocking of the Address Counter by DISP_CLK.

This sequence of events just described completes an acquisition and transfer of data. If the instrument is not in single-sweep mode, or if it is and SS_RST is asserted, the cycle is repeated.

In STORE mode with a SEC/DIV setting lower than 50 ms, the instrument is in ROLL mode. The ROLL_S line is asserted in this mode. At the start of a ROLL acquisition the Record State Machine still goes through the initialization sequence as described above. After initialization the state machine waits until DISP_SYNC is asserted by the display controller and then starts the Roll State Machine by asserting the ST_ROLL line. The DISP_SYNC signal is used to synchronize the ROLL display to the Display system.

The Record State Machine then places outputs that are common with the Roll State Machine into a high impedance state and waits for FIN_ROLL to be asserted by the Roll State Machine. At the end of ROLL mode operation, indicated by the FIN_ROLL signal being asserted, the Record State Machine returns to the initialization sequence.

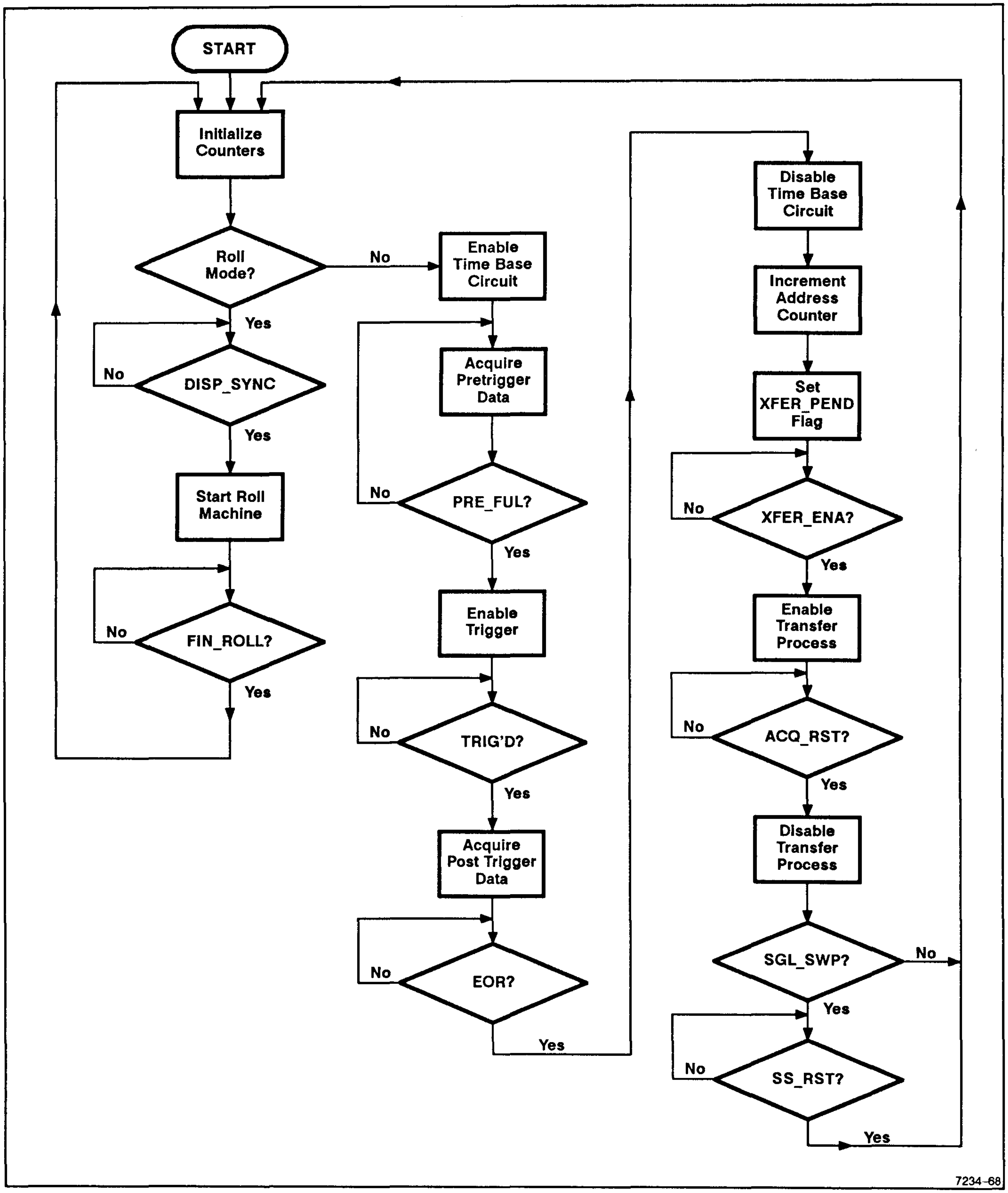


Figure 3-6. Record Mode flow diagram.

Roll State Machine

The Roll State Machine has a total of 11 inputs and 15 active outputs. The state of the outputs is purely a function of the current state of the machine. The state machine is clocked by the 20-MHz system clock. The operation of the state machine will now be described for a typical ROLL mode acquisition. See Figure 3-7 for the Roll Mode flow diagram.

After power up or the completion of a previous acquisition cycle, the Roll State Machine enters an idle state until ST_ROLL is asserted. When ST_ROLL gets asserted, the Roll State Machine enables DISP_CLK and AC_ENA to the Address Counter. This it does by asserting DISP_CLK_ENA which selects the correct output from the Timing Generator. ROLL_DISP is also asserted and signals the Display Controller that the Roll State Machine is active and that a SAV_CLK_P has not yet occurred. This enables the Display system to produce DISP_CLK pulses in ROLL mode as long as it is asserted. ACQ_ENA is also asserted, enabling the Time Base circuit to start producing SAV_CLK_P. The SAV_CLK_P signal is a delayed and resynchronized version of SAV_CLK(L), the sampling clock.

When a SAV_CLK_P signal is detected by the Roll State Machine, the machine waits until the next occurrence of END_PT. The END_PT signal indicates that the display system has reached the end of the present point-display cycle. The state machine then inhibits further display clocks by unasserting ROLL_DISP.

DISP_CLK_ENA is also unasserted while DA_CLK is asserted, and the current display address is latched into the Display Address Register (U1516 and U1517). The address stored in the Acquisition Address Register (U1518 and U1519) is now placed on the Parallel-Load Value (PLV) bus by asserting AA_OE(L) and loaded into the Address Counter by toggling SL_REC_CLK. This sets up the address where the new data sample is to be stored. The data sample is written into RAM by toggling SL_WR_CLK. The SL_WR_CLK signal is used by the Timing Generator to generate a WR_CLK(L) pulse that writes the data into the Acquisition RAM on its rising edge.

The Address Counter is then incremented by using SL_REC_CLK to point to the next acquisition address. This address is then latched into the Acquisition Address Register by the AA_CLK. The previously latched display address is now retrieved by asserting DA_OE and AC_LOAD(L) while toggling SL_REC_CLK. After loading the address into the Address Counter, DA_OE and AC_LOAD(L) are unasserted, and the Address Counter is again incremented using SL_REC_CLK to point to the next display address. The DISP_CLK_ENA and ROLL_DISP outputs are then asserted, and the system continues with the ROLL display sequence until the next SAV_CLK_P pulse appears.

The ROLL-acquisition process repeats indefinitely unless the instrument is in a triggered ROLL mode (single-sweep trigger mode) or the operator changes the front panel settings. If in single-sweep ROLL mode, the occurrence of PRE_FUL causes the Roll State Machine to assert TRIG_ENA to enable the Trigger Synchronizer circuit just as in RECORD mode. After a trigger arrives (indicated by TRIG_D being asserted) the machine enables the Record Counter during the write sequence to the RAMs. This ensures that the Record Counter is only clocked once for each SAV_CLK_P that occurs.

Each time the Address Counter is loaded with a new acquisition address, the state machine checks for the EOR signal. When this input becomes asserted, the ACQ_ENA output is unasserted and the current acquisition is ended. The display address is recovered from the Display Address Register and loaded into the Address Counter. Then the Display system is enabled by asserting DISP_CLK_ENA and ROLL_DISP to resume to display process.

The display process continues (with no further acquisitions) until the SGL SWP RESET button is pressed to assert the SS_RST input to the state machine or the trigger mode is changed.

If SS_RST gets asserted (RESET button pressed), then the ROLL State Machine sets the entire block of Acquisition RAM to contain the value 255. This has the effect of placing the trace off the screen to avoid having a discontinuous display. The process of presetting the RAM is done at a 20 MHz rate and not the acquisition rate. The operator sees the screen clear, then newly acquired points begin appearing on the right hand side of the display.

Presetting the RAM is carried out by first unasserting the DISP_CLK_ENA line and then asserting the AC_ENA, AC_CLR, SL_REC_CLK and SL_WR_CLK lines. The Channel Data Latches (U1504 and U1505) are disabled by the rising edge of AC_CLR, and the RAM data lines are pulled up HI by resistors in resistor packs RP1502 and RP1503. This sets the Address Counter to zero and hence the first RAM location to all 1's following the arrival of WR_CLK(L).

The state machine then generates SL_REC_CLK and SL_WR_CLK until PRE_FUL is detected. As the address counter was initially set to zero the occurred of PRE_FUL indicates that RAM has been set to all 1's. The state machine then asserts FIN_ROLL and returns to the idle state. During the idle state, the Record State Machine sets up the Address and Record Counters for single-sweep operation.

TIMING GENERATOR (diagram 19)

The components associated with the Timing Generator are U1755, U1756, U1757, U1759, U1524D and U7002B and C. The function of the Timing Generator is to synchronize and select the correct source of the clock for the Address and Record Counters. There are four active clock inputs as well as the 40-MHz system clock and two active outputs. Synchronizing the DISP_CLK, SL_REC_CLK, and SL_WR_CLK to the system clock is done by U1759. This ensures accurate timing relationships with the 40-MHz clock and compensates for the time delays through the Data Selectors U1755 and U1756.

Data Selectors U1755 and U1756 select the source of the clock signal for the counters depending on the state of the control lines. In RECORD mode, the SAV_CLK(L) input is the source and is selected whenever SL_CLK_ENA is LO. Both REC_CLK and WR_CLK(L) are derived from SAV_CLK(L). SL_CLK_ENA being LO also inhibits DISP_CLK and SL_REC_CLK at U1755 and SL_WR_CLK at U1756.

If SL_CLK_ENA is HI, then SL_WR_CLK becomes the source of the WR_CLK(L) output. The source for REC_CLK is SL_REC_CLK if DISP_CLK_ENA is LO; it is DISP_CLK if DISP_CLK_ENA is HI. Flip-flop U1757 again synchronizes the output signals to the 40-MHz system clock while flip-flop U1759 delays the WR_CLK(L) output by one clock cycle.

ALT TRIGGER CIRCUIT (diagrams 18 and 29)

The components of the Alt Vert Trigger circuit are U1502C, U1765A (diagram 18), U1766A, U1752B, U1764A, U1764B and U1765D (diagram 29). The Trigger Enable Latch consists of U1752A and U1750B, and the Trigger Synchronizer circuit consists of U1521C, U1750C, U1751 and U1764D.

In NORM Trigger MODE, U1752B is held in a state where both outputs are forced HI. This is accomplished by forcing both preset and clear inputs LO from U1766A. As either CH1_TRIG or CH2_TRIG will be HI then TRIG_ENA_D will also be asserted. This signal is the enabling line for the Trigger Enable Latch output.

In ALT MODE, the correct trigger source (CH 1 or CH 2) must be selected to enable the Trigger Synchronizer circuit. In ALT VERT mode, CH1(L) , CH2(L) and ALT VERT(L) are all HI, thereby releasing U1752B. On the next XFER_PEND assertion, the state of CH1_TRIG is clocked into U1752B and, if asserted, selects CH2_TRIG as the next trigger source. If CH2_TRIG is unasserted, then CH1_TRIG is selected as the next trigger source. The correct trigger source is chosen as appropriate by U1764A , U1764B and U1765D connected as an AND-OR data selector.

The trigger synchronizer works as follows: Latch U1752A gets cleared prior to an acquisition by ACQ_ENA going LO. Latch U1751 is normally held in a cleared state until the Record State Machine asserts TRIG_ENA. TRIG_ENA going HI clocks U1752A setting TRIGD_CLR HI and removing the clear signal from U1751, enabling the Synchronizer to respond to the next GATE signal. Latch U1751A gets clocked by the GATE signal, and it's output is synchronized to the 20 MHz_ACQ clock by U1751B. In SGL SWP mode, U1750B, U1750C and U1764D generate ENA_TRIG_SS(L) which is unasserted after TRIG_ENA has occurred. The ENA_TRIG_SS(L) signal is used by the analog part of the instrument to inhibit sweeps.

DISPLAY SYSTEM (diagram 31)

The Display System is divided into two main areas: the Display Data Path (diagram 24) and the Display Controller (diagram 23). The main parts of the Display Data Path consist of the Address Counter, Display RAM, and Status registers. The control section consists of the three state machines: Display State Machine, Block State Machine, and Timing Generator, and the necessary control logic to provide the output enable signals for the Display RAM and the Z-Axis circuit control lines.

DISPLAY DATA PATH (diagram 24)

The Display Address Counter, U2001, generates the addresses for the Display RAMs, U2006 and U2005. Selection between these two RAMs for display or writing data into them is by address line DRA13. That signal is inverted by U2004A to drive the output enable line of U2005. The two Display RAMS (Waveform and Reference) are cycled through completely for each display sequence. The display sequence is in the order CH 1, CH 2, REF 1 and REF 2. Each 4k data block is separated by the retrace period. A data block not selected for display is blanked during the display period for that data.

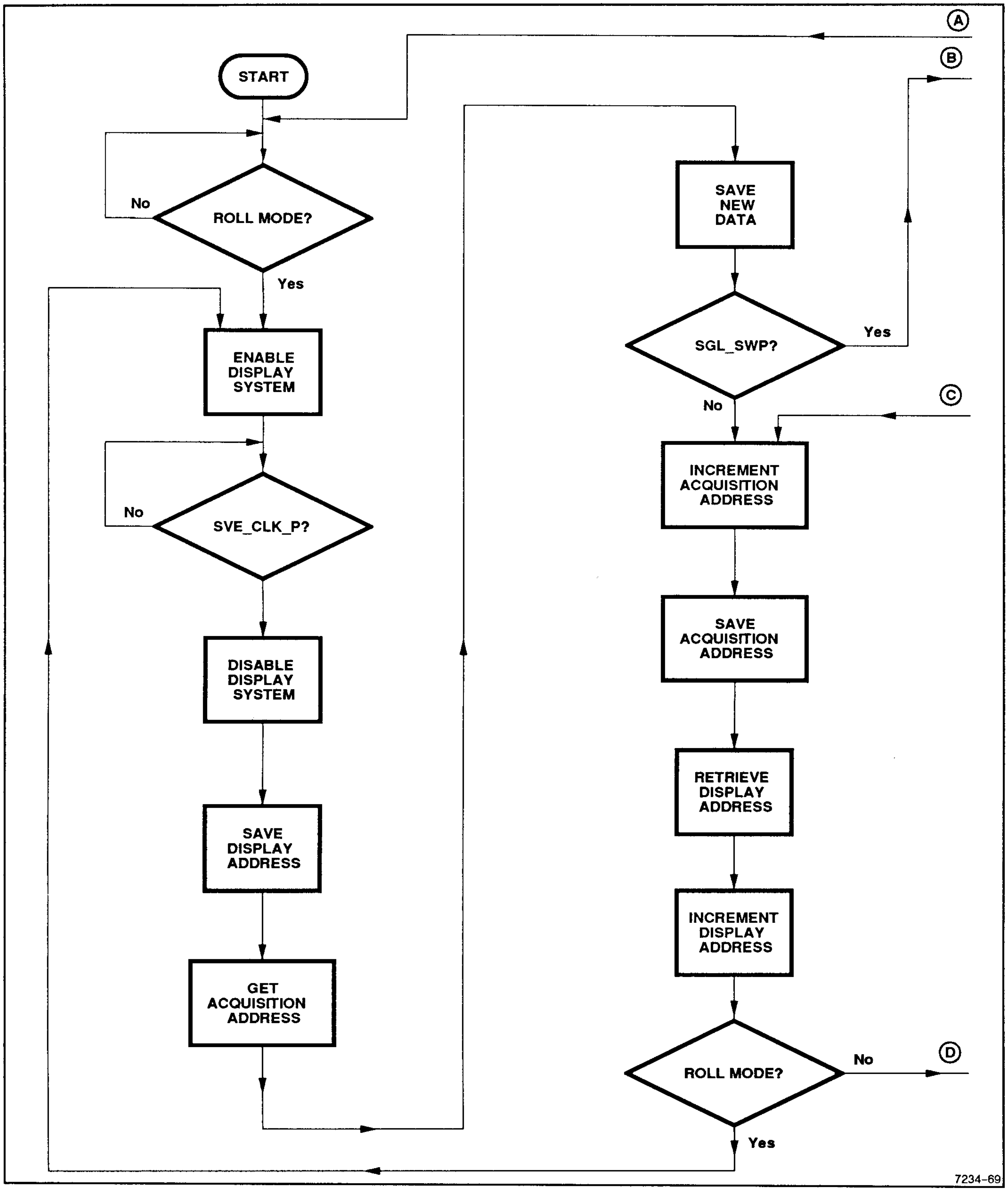


Figure 3-7a. Roll Mode flow diagram.

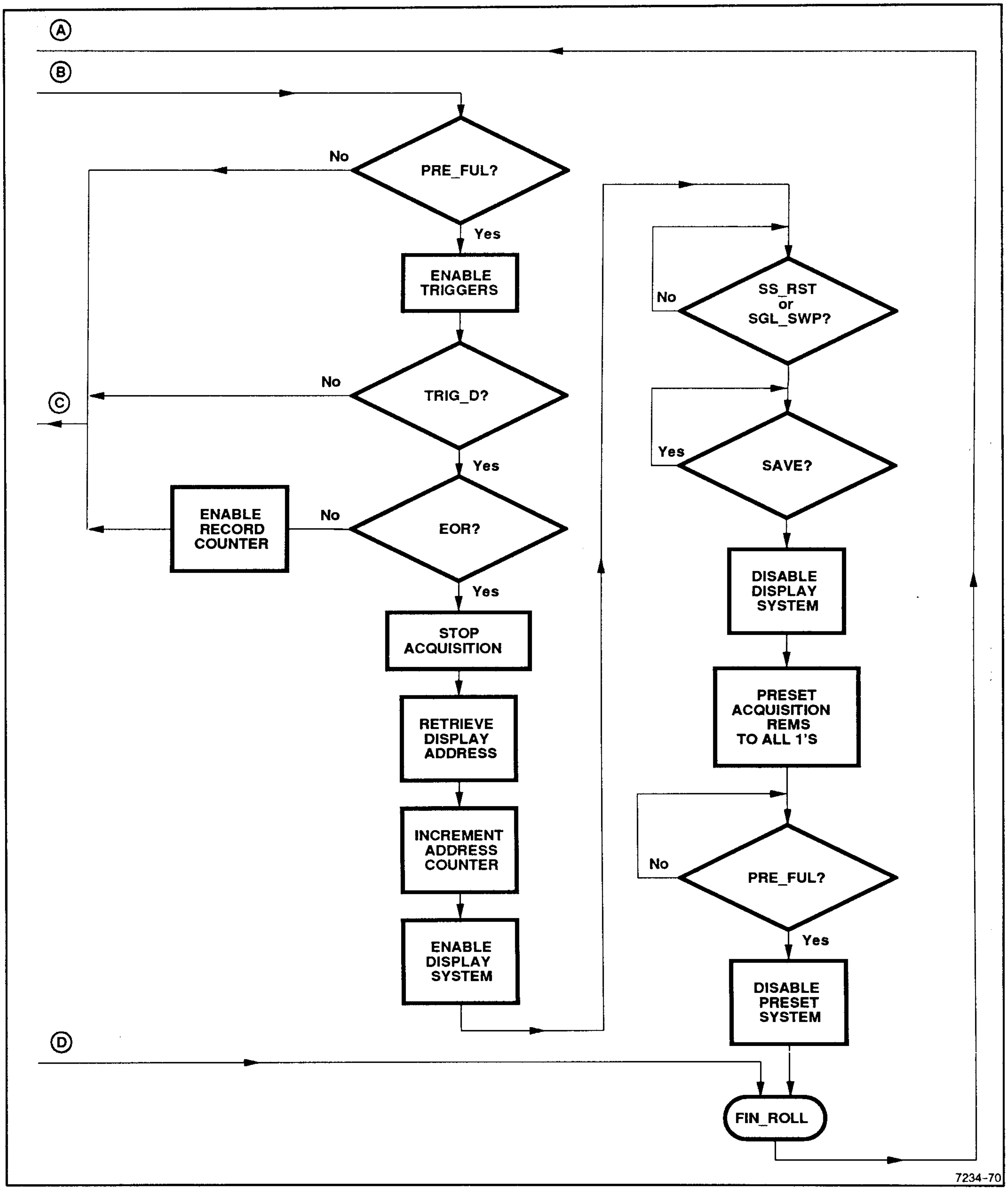


Figure 3-7b. Roll Mode flow diagram.

Data Transfer

For a RECORD mode acquisition, the newly acquired waveform data is displayed as it gets transferred from the Acquisition RAM to the Waveform RAM. During data transfer, the outputs of the both Display RAMs are disabled and the data from the Channel Display Buffers (from the Acquisition RAM) appears on the DRD(0-7) bus. That data is latched into the Vertical DAC latch for display and written into the Waveform RAM where it is available for display until the next acquisition is finished and a new transfer is done. Transferring new waveform data into the Reference RAM for a SAVE REF is done by enabling the Reference RAM as data is displayed from the Waveform RAM.

After the RECORD transfer is finished, as indicated by the Display Controller asserting ACQ_RST, the display sequence continues with waveform data being sourced from the Waveform RAM and the Reference RAM. If SAVE mode is entered, the Acquisition is allowed to finish, but the Waveform RAM is never updated.

In ROLL mode, data is always displayed directly from the Acquisition RAM. The Waveform RAM chip select remains inactive from U2253A (diagram 23) through the logic states of ST_ROLL and DRA13. If a SAV REF operation is executed, data is transferred to the Reference RAM from the Acquisition RAM. The display process then continues, with the Acquisition RAM providing CH 1 and CH 2 data and the Reference RAM providing reference waveform data.

When SAVE mode is entered from ROLL mode, the Acquisition RAM does not get updated with new point data, and the waveform data continues to be sourced from the Acquisition RAM.

Display Address Counter and Ramp Generator

The Display Address Counter, U2001, acts as a 13-bit address generator for Waveform RAM U2006 and Reference RAM U2005. It has five active inputs: DC_CLR, SPT, WFC(L), TP_ENA_S and DISP_CLK. DC_CLR resets the counter to zero after a power-on reset; DISP_CLK is the clock input sourced from the Display Timing Generator. The Short Pretrigger signal (SPT) indicates to the counter the relative trigger-point position (25% or 75%) as selected by the operator and determines the address when TP_ENA_S is asserted (trigger point enabled). WFC(L) starts a waveform cursor (STORE mode time cursor) dwell cycle.

Two other signals are generated by the counter: 4K_TC and TP/WFC. The 4K_TC signal signifies the end of a 4K block of data (Terminal Count). This signal is active at each of the 4K boundaries corresponding to the end of CH1, CH2, REF1, and REF2 data blocks. The trigger point and waveform cursor signal (TP/WFC) is active during the period that the address corresponds to the selected trigger position or the period during which waveform cursor segments are to be displayed.

Status Registers

The Wave Status Register, U2002, contains the status information relating to the data in the Waveform RAM U2006. The Reference Status Register, U2003, contains the status information relating to the data in the Reference RAM U2005.

These two registers are pipelined with the Acquisition Status Register. The Wave Status Register is updated by WS_UPDT from the Acquisition Status Register at the start of a transfer. The Reference Status Register is updated by RS_CLK at the start of a CH 1 display period if a SAV_REF has been initiated by the operator.

The output enables for these two registers are derived from the address counter. DRA13 is used to enable the Wave Status Register while DRA13(L) enables the Reference Status Register and also generates REF_POS(L). During the reference display period, REF_POS(L) is asserted. This signal is used to enable the Reference Position circuit (diagram 3).

The reference status register, U2003, can be serially written to or read from under control of the serial interface board. For an explanation of this control, refer to the serial interface circuit description.

Vertical Output

The output data from the Waveform and Reference RAM, under control of WAVE_OE(L) and DRA13(L) appears on the DRD(0-7) data bus DRD(0-7) before being latched into Vertical DAC Latch on the cursor/readout board. The latching signal END_PT is generated by the Display Timing Generator.

DISPLAY CONTROLLER (diagram 23)

The Display System (diagram 31) is controlled by three state machines. The Display State Machine U2261, the Block State Machine U2262, and the Display Timing Generator U2259, are all preprogrammed, CMOS PAL (programmable array logic) devices.

The other components of the control system include the Block Decoding logic, the Trigger and Retrace monostable multi vibrators, and associated logic components. These components are used to interface to the Acquisition System and the Display Data Path.

Display State Machine

The Display State Machine U2261 has a total of 14 inputs and 6 active outputs. The state of these 6 outputs is purely a function of the current state of the machine. A seventh output is VALID_TRIG, a combination logic signal that qualifies the CH 1 and CH 2 data transfer during VERT MODE trigger operation. Validating is a function of the input variables ALT_VERT_BOTH, BLKO(L), BLK1(L), CH1_TRIG, and CH2_TRIG.

The state machine is clocked by the 20-MHz system clock. The operation of the state machine will now be described for a typical display sequence. See Figure 3-8 for the Display States flow diagram.

After power up or after the end of a block process, the Display State Machine enters the display-enable state. In this state, the Display Timing Generator is enabled by asserting DISP_ENA. The machine then waits for the end of the data block (4K_TC_S asserted from U2008) unless the trigger point or cursors are to be displayed.

The machine waits for TP/WFC_S or 4K_TC_S from the Display Address Counter. When TP/WFC_S gets asserted, the Display State Machine initiates the Trigger/Waveform cursor Monostable U2257B by asserting TRIG_TP/WFC(L) and disables the Timing Generator. The Trigger/Waveform cursor Monostable generates a 120-us pulse (timing set by components R2251 and C2251). The monostable output, TP/WFC_MONO, is synchronized by U1500 and fed back to the state machine. Synchronization of TP/WFC and 4K_TC is done by U2008. During this period, U2258B and U1750D assert DWELL(L) which inhibits the Storage Ramp (diagram 7).

At the end of the trigger or cursor display period, the machine enables the Timing Generator and waits for the end of the data block (4K_TC_S asserted).

At the end of the data block the display is blanked by asserting BLANK, and the Retrace Monostable multivibrator (U2257A) is triggered by TRIG_RET. The retrace period, set by R2250 and C2250, is 1 ms. After the retrace period, the Block States Machine is then started by asserting BP_START. The Display State Machine waits until the Block process is finished. This is detected by BP_FINISH being asserted, at which point the machine returns to the display-enable state. This sequence repeats indefinitely.

Block State Machine

The Block State Machine U2262 has a total of 12 inputs and 8 active outputs. The state of the outputs is purely a function of the current state of the machine except ALT_BLANK. ALT_BLANK is dependent on the inputs DS6, BLKO(L), BLK1(L), BLK2(L), BLK3(L) and CH1_TRIG. The operation of the Block State Machine will now be described for a typical display sequence. See Figure 3-9 for the Block States flow diagram. Table 3-1 summarizes the Block Process Activities.

After power up, the machine enters a wait state until BP_START is asserted. When BP_START is asserted, the next state depends on the value of the inputs and on which block has just been displayed. The current block is determined by the BLKO(L), BLK1(L) and BLK2(L) inputs. These inputs are generated from a 2-to-4 line decoder U2256A driven by the two most significant lines of the address bus. BLKO(L), BLK1(L) and BLK2(L) correspond to CH1, CH2 and REF1 respectively. Block 3 is the Reference 2 data block, but no specific functions take place during Block 3 except for the display of Reference 2 data. Therefore, a BLK3(L) signal is not needed in the state machine.

In Block 0 (BLKO(L) asserted) with the SAV_REF signal HI, the REF_WR flag (U2254A) is set by asserting REF_WR_ENA. RS_CLK is also asserted to latch the data into the Reference Status Latch.

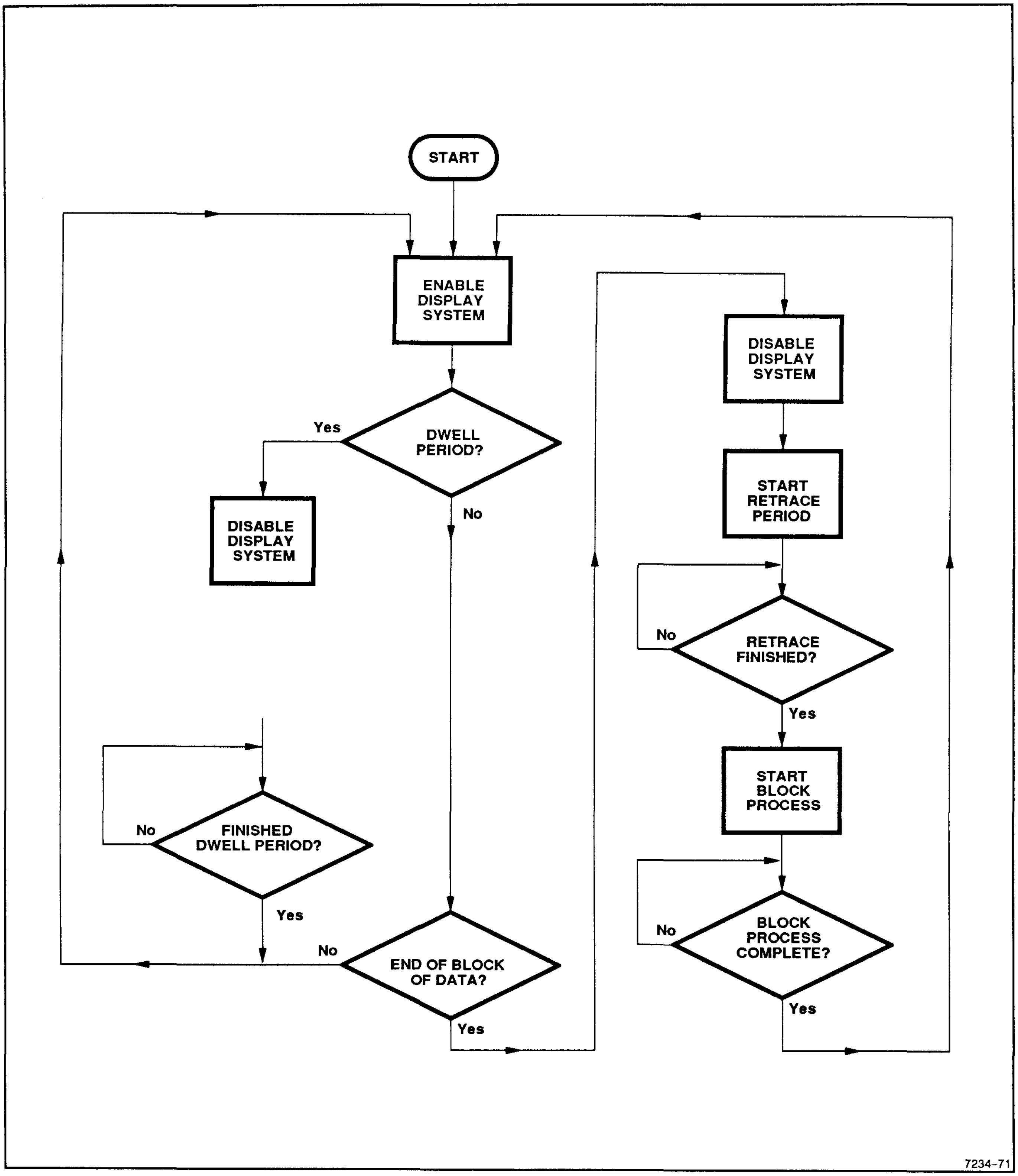


Figure 3-8. Display States flow diagram.

Table 3-1
Block Activities

<table>
<tr><th>BLOCK</th><th>DISPLAY</th><th>RECORD Mode Events</th><th>ROLL Mode Events</th></tr>
<tr><td>BLOCK 0</td><td>CH 1 Data</td><td rowspan="2">Display data from the Waveform RAM.

Write data to the Waveform RAM from the Acquisition RAM for a RECORD transfer (data is displayed during transfer).

Transfer data from the Waveform RAM to the Reference RAM for a SAVE REF (data is displayed during transfer).</td><td rowspan="2">Display data from the Acquisition RAM.

Write data to the Reference RAM from the Acquisition RAM for a SAVE REF (data is displayed during transfer).</td></tr>
<tr><td>BLOCK 1</td><td>CH 2 Data</td></tr>
<tr><td>BLOCK 2</td><td>REF 1 Data</td><td colspan="2" rowspan="2">Display data from the Reference RAM</td></tr>
<tr><td>BLOCK 3</td><td>REF 2 Data</td></tr>
</table>

In Block 0 and with a XFER_PEND signal (and SAVE_REF not asserted), WS_CLK(L) and XFER_ENA are asserted. In RECORD mode WS_CLK(L) is selected by U1520, and the acquisition status information is latched into the Wave Status Register. The XFER_ENA signal sets the XFER flag (U2258A) and signals the Acquisition system that a transfer can take place. Data is then transferred to the Vertical DAC for display and written to the Waveform RAM during the next two display sweeps if selected.

In Block 0, SAVE_REF takes precedence over a XFER_PEND. If both are asserted, the XFER_PEND will be ignored until the next display sequence starts, at the next occurrence of BLK0(L).

If in Block 1 and the XFER flag had been previously set, then the WAVE_WR flag is set provided there is a VALID_TRIG. A VALID_TRIG ensures that in ALT Vertical MODE only the required channel data is transferred.

If in Block 2 and the XFER flag is set then ACQ_RST is asserted to signal the acquisition system that the transfer has been completed. The XFER flag is then cleared in Block 3 by Block Decoder U2256A.

If the instrument is in SAVE mode, the Acquisition system is not reset until SAVE mode is left.

At the end of these operations, or if none of these conditions just described exist, the machine asserts BP_FINISH and returns to its wait state.

Display Timing Generator

The Timing Generator State Machine U2259 has a total of 11 inputs and 5 active outputs. The state of the outputs is purely a function of the current state of the machine except DS_BLANK(L), REF_WR_CLK(L) and WAVE_WR_CLK(L). DS_BLANK(L) is a combinational signal that is dependent on the inputs of DRA13, DRA12, DS1, DS2, REF_ON_S, ROLL_S and ST_ROLL. REF_WR_CLK(L) and WAVE_WR_CLK(L) are functions of the current state of the machine and the input variables REF_WR and WAVE_WR respectively. The state machine is clocked by the 20-MHz system clock. The operation of the state machine will now be described for a typical display sequence.

The Timing Generator provides DISP_CLK and END_PT. These signals are at a 1-MHz rate and clock the display Address Counter and the DAC latch respectively. The 1 MHz rate is accomplished by effectively dividing down the 20-MHz clock, producing one output pulse for every 20 cycles of the system clock. After power up or the completion of a previous cycle, the machine enters a wait state. If the instrument is not in ROLL mode and the display is enabled, a transition to the next state occurs. If in ROLL mode, then ST_ROLL and ROLL_DISP must both be asserted to continue to the next state.

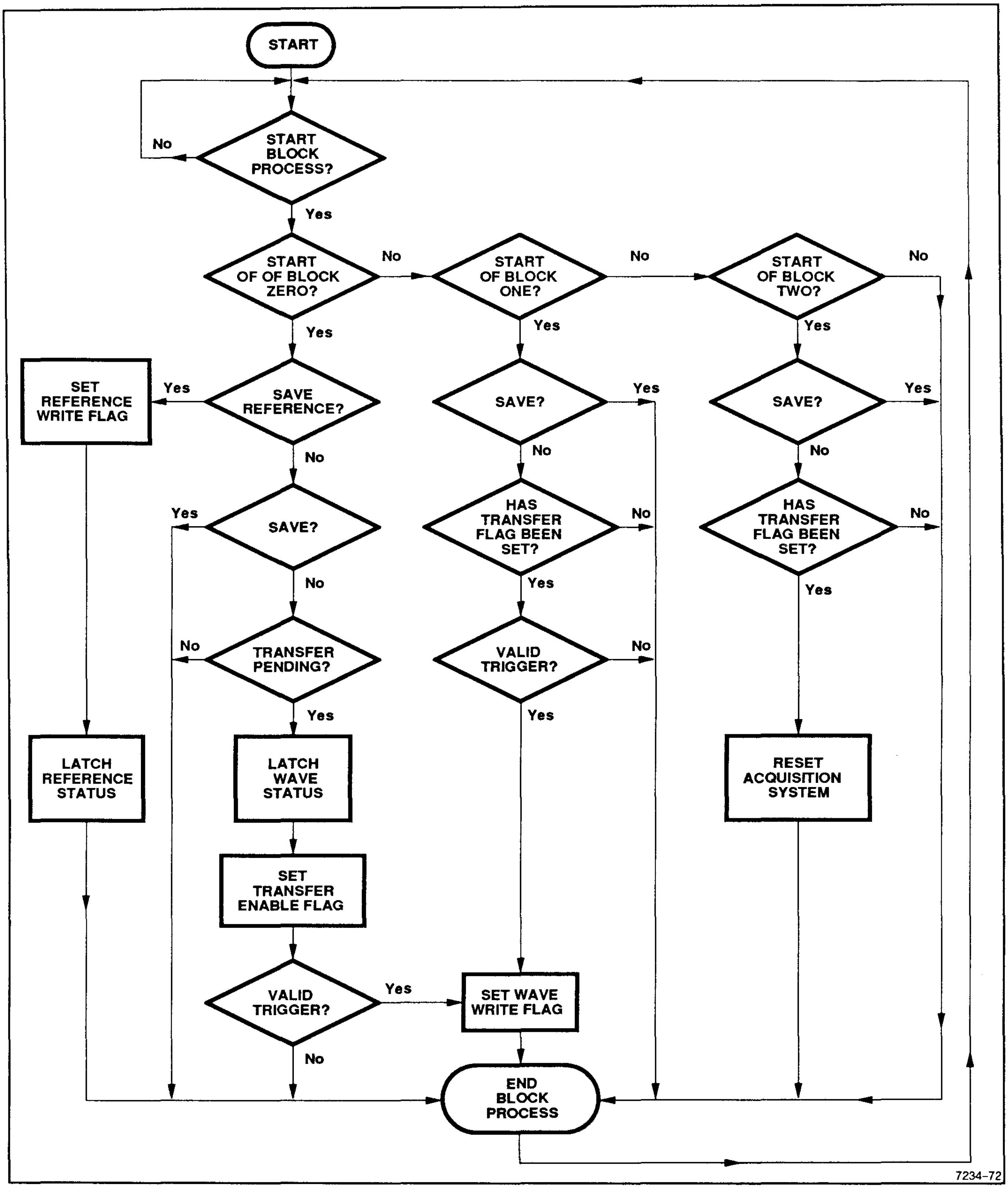


Figure 3-9. Block State Machine flow diagram.

At the end of 1 μs, if the WAV_WR flag is set, WAVE_WR_CLK(L) is asserted for 100 ns. If the REF_WR flag is set, then REF_WR_CLK is asserted for 100 ns. The state machine then asserts DISP_CLK followed by END_PT for 50 ns before returning to the wait state. This process continues as long as the display is enabled.

Control Logic

The outputs of ALT_BLANK, BLANK and DS_BLANK are combined together to produce a composite blank signal (BLANK_DISP). This is achieved by the gating circuit formed from U1764C, U1766C and U1502D. The GATE_STO signal is derived from the Display State Machine BLANK output by U1765C. This signal resets the Storage Sweep Generator during the retrace period.

The DISP_SYNC signal from U1766D is asserted at the start of the retrace period for BLOCK 0. It is used by the Record State Machine to synchronize the start of the Roll State Machine to the Display System.

The channel transfer signals are also derived from a 2-to-4 line decoder U2256B with inputs DRA12 and DRA13. In ROLL mode or during a WAV_WR process U2253C ensures the decoder is held in an enabled state. This means that CH 1 and CH 2 Display Buffers are transparent during BLOCK 0 and BLOCK 1 respectively. If there is a ST_ROLL signal but no ROLL_DISP then the Storage Ramp Generator is inhibited from ramping by DWELL(L). This is achieved through the action of U1524C and U1750D.

NAND-gate U2251B clears the WAVE_WR flag latch U2254B at the end of the 4k block when END_PT occurs. The SAV_REF flag U3006A and the REF_WR flag latch U2254A are cleared by U2253B during BLOCK 2.

TP_ENA is generated by U2008. In RECORD mode TP_ENA is normally asserted, and in ROLL mode it is unasserted. TP_ENA is used by the Display Address Counter to determine if the trigger point is to be displayed. Normally, in ROLL mode it is inhibited, but in single-sweep mode it is inhibited only until the pretrigger data is acquired and a trigger has occurred. In this mode TR_ROLL is normally asserted.

At the start of a ROLL single sweep acquisition INIT unasserts TP_ENA. This allows the display system to roll without a trigger point being displayed. When pretrigger data has been acquired TP_ENA is asserted which indicates to the Display Address Counter that the trigger point can now be displayed.

If DRA13 and ST_ROLL are not asserted, then U2253A enables the Waveform RAM. The output enable for this RAM comes from U1765B. The RAM is enabled when DRA13 is not asserted unless the WAVE_WR flag has been set. In this case the Waveform RAM outputs are disabled so data from the Acquisition RAM can be written into the Waveform RAM.

The REF_CS signal is generated from U2251D, U2255D and U2251A. This chip select signal for the Reference RAM is asserted when DRA13 and REF_ON_S are both asserted. The RAM is also selected if DRA13 is not asserted but the REF_WR(L) flag is set. This occurs when data is being transferred from the Waveform RAM.

CLOCK AND TIME BASE (diagram 25)

The Clock and Time Base circuit takes the 40-MHz oscillator output and generates the various timing signals needed in the acquisition. These include SAV_CLK, CONV_CLK, SAV_CLK_P and the system 20-MHz clock.

Master Clock Generator

The 40-MHz oscillator U7001 is crystal-controlled and provides an accurate 40-MHz clock that is buffered by U1521B. The output of U1521B is used for the 40-MHz system clock. That frequency is divided by two by U7006 to produce the 20-MHz system clock.

8 MHz Generator

A divide-by-five circuit formed by U7003 generates the 8-MHz signal from the 40-MHz system clock.

During the power-reset sequence, or if not in STORE mode, U7009D holds both the SAV_CLK(L) and CONV_CLK outputs (from U7008A and B) in their unasserted state. Also the Master Clock Generator, the 8-MHz Generator and the synchronization flip-flop U7017B are held in a cleared state.

Clock Source Select

The CONV_CLK output is used to clock the A/D Converters at either 20 MHz or 8 MHz, or by an EXT-CLK. The SAV_CLK(L) output is used to latch data at the required sample rate of 20 MHz, 8 MHz, SAV_CLK, or at the EXT_CLK rate.

Both of these outputs are selected by a multiplexer U7007 and then synchronized to the 40-MHz system clock by U7008. Selection of the required input is determined by the state of the select lines S0 and S1.

SAV_CLK(L) is delayed and synchronized by U1521A, U7002D, and U1767 so that there is no race condition with the 20-MHz system clock. The output of U1767B is SAV_CLK_P and is used as an input to the Roll State Machine.

Save Clock Generator

For all SEC/DIV switch settings slower than 50 μs per division, SAV_CLK(L) is generated from a programmable divider chain U7010-U7013. The four decade counters are connected as a multistage counter with look-ahead carry. At the start of an acquisition, the counters are preset as necessary via U7002A and U7009A and B by ACQ_ENA. The counters are loaded with a value corresponding to the state of the SEC/DIV switch position (see Table 3-2). The first stage counter U7010 can be loaded with either eight or six to give a division of two or four respectively. The other three counters can be preset to their terminal count (nine) or to zero to give a division of 10. Therefore each of these counters can be switched in to divide the output of the previous counter.

Table 3-2
Divider-Chain Logic Table

SEC/ DIV	DEC4(L)	DEC3(L)	DEC2(L)	DEC1B(L)	DEC1A(L)	S0	S1	ROLL	X100_ SEL(L)	CONV CLK	SAV CLK
50 n	0	0	0	1	1	1	1	0	1	20 M	20 M
0. 1 μ	0	0	0	1	1	1	1	0	1	20 M	20 M
0. 2 μ	0	0	0	1	1	1	1	0	1	20 M	20 M
0. 5 μ	0	0	0	1	1	1	1	0	1	20 M	20 M
1 μ	0	0	0	1	1	1	1	0	1	20 M	20 M
2 μ	0	0	0	1	1	1	1	0	1	20 M	20 M
5 μ	0	0	0	1	1	1	1	0	1	20 M	20 M
10 μ	1	0	0	1	1	1	1	0	1	20 M	20 M
20 μ	1	0	0	1	1	1	0	0	1	20 M	20 M
50 μ	1	0	0	1	1	0	1	0	1	8 M	8 M
0. 1 m	1	1	1	0	1	0	0	0	1	8 M	4 M
0. 2 m	1	1	1	1	0	0	0	0	1	8 M	2 M
0. 5 m	1	1	1	0	0	0	0	0	1	8 M	800 K
1 m	1	1	0	0	1	0	0	0	1	8 M	400 K
2 m	1	1	0	1	0	0	0	0	1	8 M	200 K
5 m	1	1	0	0	0	0	0	0	1	8 M	80 K
10 m	1	0	0	0	1	0	0	A	B	8 M	40 K
20 m	1	0	0	1	0	0	0	A	B	8 M	20 K
50 m	1	0	0	0	0	0	0	A	B	8 M	8 K
0. 1 s	0	0	0	0	1	0	0	1	B	8 M	4 K
0. 2 s	0	0	0	1	0	0	0	1	B	8 M	2 K
0. 5 s	0	0	0	0	0	0	0	1	B	8 M	800 Hz
xy	0	0	0	1	1	1	1	0	1	8 M	20 M

If the divide by 100 circuit is not selected by X100_SEL(L) then U7014 and U7015 are set to their terminal count. This terminal count is held by keeping the LOAD(L) inputs to the counters asserted via U7009C. If selected then both counters are loaded with 9 and then incremented by the next output from the Save Clock Generator. AND-gate U7016B inhibits the output until the X100 circuit reaches terminal count. Therefore 100 pulses are needed from the Save Clock Generator to generate one pulse from the X100 circuit.

The output of the chain from U7016B is synchronized first to the 8-MHz clock by flip-flop U7017A and then to the 40-MHz clock by flip-flop U7017B.

A indicates normally 0 unless SEC/DIV CAL is out of the detent position in which case A is 1.

B indicates X100_SEL(L) is asserted during ROLL modes only when SEC/DIV CAL is out of the detent position.

Timebase Shift Register

The Cursor/Readout circuit programmes the storage timebase from the position of the SEC/DIV switch. The control signals S0, S1, DEC1A(L), DEC1B(L), DEC2(L), DEC3(L), DEC4(L), X100_SEL(L) and ROLL_FLG are all passed serially to the nine-bit shift register comprising of U7020 and U7021A. CRMAP1_3(L) is the clocking signal for the serial transfer via CRCPUD0(L). During the transfer storage acquisitions are inhibited by ACQ_ENA_GATE which disables ACQ_E(L) after synchronization by U7021B.

ACQ_ENA_GATE is also used to disable acquisitions in ROLL mode when the Serial Interface circuit Snapshot circuit is activated.

ROLL Lock Circuit

The ROLL Lock circuit acts like a transparent latch. While the instrument is not in SAVE mode, the output ROLL is allowed to change state and the instrument can be switched in and out of ROLL mode. In SAVE mode the instrument is not allowed to change states as the SEC/DIV switch is changed between RECORD and ROLL modes.

External Clock Buffer

The External Clock Buffer circuit conditions the external clock input signal. This circuit provides a high input impedance with overvoltage protection for externally applied clock signals.

Diodes CR7501 and CR7502 ensure that input voltages outside the range of 0-5 V are not applied to FETs Q7503A and Q7503B. Excess voltage is dropped across R7501. For a complete specification of allowable input voltages for all frequencies see Figure 1-2 in Section 1. The capacitor pair C7501-C7502 provides correct high frequency compensation.

The dual-FET input (Q7503A and Q7503B) provides high input impedance, and the two transistors are matched for equal current at zero gate voltage. This ensures that there is no offset voltage introduced by Q7503A. Resistor R7502 sets the input resistance at 1M Ω.

The external clock signal from Q7503A is buffered by Schmitt amplifier U3203A before being applied to U7006. Two of the flip-flops in U7006 are used to provide two levels of synchronization. The output of U7006 is fed to multiplexer U7007 as a source for SAV_CLK and CONV_CLK.

POWER RESET AND STORAGE SWITCHES (diagram 26)

The power reset circuit consists of R3201, CR3200, C3201, U3203A and B, and U3204B. The RC time constant is approximately 0.5 s. The PWR_RST is HI during the switch-on period. The Storage system is held reset if the instrument is not in STORE mode. The SAV_REF flag, from U3006B, and the REF-ON flag from U3005B are also cleared at this time by the action of U3204C and U3203A respectively. The switch debounce function is provided by a pair of cross-coupled inverters. Debounce is provided by U3001 and U3002 for five of the front panel switches.

CURSOR/READOUT CPU (diagram 39)

A quartz crystal oscillator (Y1300, U1300A and B) runs at 4.9152MHz to provide a clock (P_CLOCK) for the Cursor/Readout CPU and logic circuits and for the Serial Interface CPU and logic circuits.

A reset circuit (Q1377, U1328B) provides a signal PWR_RST(L) which is LO for about 0.3 s after power is applied to the 2211.

The Central Processing Unit (CPU) U1302 operates with the low order address bus time multiplexed with the data bus. U1303 separates the low order address bus CRCPUA[0..7] from the data bus CRCPUD[0..7]. The

CPU generates a timing signal CRCPUAS for this purpose.

ICs U1306 and U1307 decode address segments corresponding to physical addresses of the Cursor/Readout CPU memory locations and peripherals.

The CPU runs a fixed programme stored in the Read Only Memory (ROM) U1305. U1304 provides read/write data storage.

The CPU can write to U1315 with U1309 acting as a buffer on the data bus. U1310, U1311, U1312 and U1313 act as an address bus latch for address bits CRCPUA[0..11]. The high order address bits CRCPUA[8..15] will change before the write cycle to U1315 ends. U1310 latches the address bits required by U1313.

CPU access to memory locations in the range hexadecimal 1000 to 1FFF will result in CRMAP1(L) being asserted LO. This asserts the LOAD function on U1311, U1312 and U1313, which load the required address value for a write operation to U1315.

The data written to U1315 consist of pairs of bytes stored in consecutive locations. These can be either Y and X co-ordinates for a pixel of Cursor/Readout display or a flag and control code for the Cursor/Readout Display controller. The data written to U1315 define the Cursor and Readout display and are only updated when the display is to change.

The high order address bit input to U1315 is driven by the signal BANK_SW from the CPU. The CRT Cursor/Readout display can be switched between two independent displays by setting BANK_SW HI or LO.

The write pulse to U1315 is generated by U1314A and U1308D. When CRMAP1(L) is asserted LO the output pin 6 of U1314A is asserted HI during the next CPU cycle.

The low order address demultiplex signal CRCPUAS is used to control timing of the write pulse in the CPU cycle following a Cursor/Readout display write operation.

The signal ADVANCE(L) from the cursor/readout display controller is used to control the operation of U1311, U1312 and U1313 when they operate as memory address counters for read operations from U1315. ADVANCE(L) is asserted LO for one clock cycle (203ns) and is stretched to two cycles by U1314B and U1308C. The stretched pulse advances the address count value by two for each display dot. U1314B delays ADVANCE(L) by one clock (203ns) to generate CR_PIXEL_CLK. The trailing (rising) edge of this pulse latches the vertical and horizontal deflection values for a display dot into the vertical and horizontal DAC latches respectively.

The CPU address segments allocated to memory are referred to as SYSTEM ROM, SYSTEM RAM and DISPLAY RAM on the schematic, and are decoded by U1328C (SYSTEM ROM) and U1306, U1308B.

U1307 decodes the address space further to generate a series of signals to activate peripheral circuits.

HOST INTERFACE (diagram 41)

To generate the Cursor/Readout display the CPU must identify the positions of selected front panel controls. Many of the controls drive the parallel load logic inputs of a shift register chain distributed through the 2211. This chain includes U1345. The parallel load inputs to U1345 connect to the four CURSORS push buttons S1335, S1336, S1337, S1338 and the PUSH SELECT ACTIVE CURSOR switch contact R1307C. The shift register chain terminates at U1342. The shift register chain loads data in parallel from the front panel settings when the CPU address decode CRMAP0_4(L) is LO. The shift register chain shifts data one bit towards U1342 when address decode CRMAP0_5(L) is LO. U1342 drives its stored data onto the CPU data bus when CRMAP0_0(L) is LO. A parallel load is followed by repeated sequence of shifts and read operations. This allows the CPU to read all logic levels present on all shift register parallel load inputs.

Some of the information required to generate Cursor/Readout displays is in the form of analog voltage levels. U1341 is an eight input eight bit analog to Digital Converter (ADC). U1340 is a 5 volt reference device used to drive the reference and supply of U1341. When the CPU address decode CRMAP0_1(L) is LO U1341 selects one of eight analog input channels defined by address bits CRCPUA[0..2] and starts an analog to digital conversion. The conversion time is controlled by a clock signal (614 kHz) and is approximately 100 μs. The signal CONV_CPLT is LO for the duration of the conversion cycle. When the conversion is complete CONV_CPLT goes HI and the conversion result is ready to be read. When the CPU address decode CRMAP0_2(L) is LO U1341 drives the conversion result onto the CPU data bus CRCPUD[0..7].

TRIGGER LEVEL, stored reference position offset REF POS, CURSORS position control wiper outputs and probe encoding ring voltages are connected to the analog inputs of U1341. The TRIGGER LEVEL voltage is generated by the trigger level readout amplifier U1344B.

The CURSORS position control wiper outputs and stored reference position offsets are buffered by the voltage followers U1350A and B and U1344A.

CURSOR AND READOUT DISPLAY CONTROLLER (diagram 40)

To display the Cursor and Readout field on the CRT requires that time is allocated that cannot be used to display traces. The circuit that controls Cursor/Readout timing operates in several quite distinct modes.

In STORE mode the storage system can display from one to four waveforms on the screen. The timing of the display refresh cycle is independent of the number of traces being displayed. The vertical and horizontal deflections for traces that are not displayed on the CRT are driven to the CRT deflection amplifiers. The intensity is only asserted for traces being displayed.

In STORE mode with voltage cursors or no cursors the Cursor/Readout display occurs during the interval between trace displays, approximately 1 ms per trace. During each 'retrace' period one quarter of the cursor/readout display is written to the CRT.

In STORE mode with time cursors the readout display occurs during the interval between trace display (as voltage Cursor/Readout), but the cursors are displayed in time intervals occurring during the traces (whether a trace is displayed or not). During three of the four traces time intervals occur when one-third part of each cursor is drawn.

In NON-STORE mode the Cursor/Readout display updates with a repetition rate defined by a counter consisting of U1323, U1324, U1325 and part of U1326. The repetition period is about 20 milliseconds.

In NON-STORE mode with fast SEC/DIV settings selected the display refresh lasts about 2 milliseconds.

In NON-STORE mode with slow SEC/DIV setting selected the display updates at the same rate as for fast sweeps, but the display refresh occurs in multiple bursts of one to four pixels instead of a continuous stream. Time intervals lasting about 10 μs are taken from the trace for Cursor/Readout pixel display. These timeslots have a repetition rate of about 50 μs. When the display refresh is complete (after about 12 ms) the trace is uninterrupted until a new Cursor/Readout display update cycle starts.

The Cursor/Readout timing counter consisting of U1323, U1324, U1325 and part of U1326 generates several timing signals. U1323 divides the CPU cycle clock by 12 to give approximately 100kHz, required for NON-STORE display timing. U1323 also generates 614 kHz to clock the ADC U1341.

In NON-STORE mode U1324 divides the 100kHz output of U1323 to give timing signals that control the switch from trace display to Cursor/Readout display. The timing signal RT_PXL is HI for 10 μs and LO for 40 μs. While RT_PXL is HI the Cursor/Readout display system is enabled and can display pixels on the CRT.

U1325 counts the signal RT_PXL, and passes the count value high order bits Q6, Q7, Q8 and Q9 to U1326.

U1326 is a programmed logic device which generates three timing signals. When the signal CPU_W_E is HI the CPU is granted write-only access to the Cursor/Readout display RAM U1315. During this time (4 to 5 ms) the display system will not access this memory. When CPU_W_E goes LO the display system is reset and a Cursor/Readout display refresh starts. The display refresh cycle will be complete before CPU_W_E goes HI again after about 15 ms. In NON-STORE mode the timing of CPU_W_E is determined by U1325 count outputs Q6, Q7, Q8 and Q9. In STORE mode the retrace signal S_RET_MONO defines the timing of CPU_W_E with phase determined by DISP_SYNC.

U1326 generates a reset pulse to clear the counter U1325.

U1326 generates a signal DITHER2 to pseudo-randomize the count sequence of U1324. This reduces the visibility of the gaps in NON-STORE traces.

The count sequence of U1323 is pseudo-randomized by CONV_CPLT.

U1369 is a programmed logic device which generates timing signals and controls Storage/Cursor/Readout intensity, COMP_Z(L).

In STORE mode U1369 generates a synthetic retrace signal S_RET_MONO from the storage display terminal count signal TC_1.

In STORE mode U1369 generates the storage Cursor/Readout signal ST_CR(L). When ST_CR(L) is LO Cursor/Readout display is enabled. This signal includes the STORE mode trace display retrace periods (about 1 ms) and the time cursor display periods (about 100 μs) if time cursors are selected.

U1369 generates a signal HDAC_EN which, when HI, switches the CRT horizontal deflection from the sweep to the Cursor/Readout horizontal deflection value.

U1369 generates a signal TEN_BIT_EN(L) from the Cursor/Readout display RAM address bits CRDRA9, CRDRA10 and CRDRA11. When these bits are all LO during NON-STORE cursor display TEN_BIT_EN(L) is set LO. When TEN_BIT_EN(L) is asserted LO the NON-STORE cursor offset generator U1364 and U1365 is enabled.

U1320 is a programmed logic device which controls the display of Cursor/Readout pixels on the CRT. U1320 generates CR_YDAC_EN which, when HI, switches the CRT vertical deflection from the trace to the Cursor/Readout vertical deflection value.

U1320 generates A11_Z(L) which is the Cursor/Readout pixel intensity. A logic LO level indicates a pixel 'on'.

U1320 generates signals ADVANCE(L) and CLEAR(L) which control the Cursor/Readout display RAM address counter U1311, U1312 and U1313. When CLEAR(L) is LO the counter chain is cleared to zero. ADVANCE(L) goes LO for one clock cycle (203ns) each pixel display cycle. U1314B and U1308C stretch this pulse to two cycles duration. The counter chain U1311, U1312 and U1313 advances two counts, so two consecutive data bytes are read from U1315 onto the Cursor/Readout display RAM data bus CRDRD[0..7]. The signal ADVANCE(L) clocks the first of these bytes into U1321 and U1322. If the first of these bytes is [HI, HI, HI, HI, HI, HI, HI, HI] then U1322 sets CTL_BYTE HI and CRDRD0 (EOL) and CRDRD1 (EOF) are interpreted by U1320 as timing control bits. If U1322 does not set CTL_BYTE HI, then the data value in U1321 and U1322 (YDEF[0..7]) is the Cursor/Readout vertical deflection value and CRDRD[0..7] is the Cursor/Readout horizontal deflection value.

HORIZONTAL AND VERTICAL MULTIPLEXERS AND DRIVERS (diagram 42)

The horizontal deflection of the CRT must be switched from the STORE mode or NON-STORE mode sweep to the Cursor/Readout pixel horizontal deflection values.

When HDAC_EN is LO the sweep circuit (on the A2) drives a differential current mode signal (TIMEBASE+ and TIMEBASE-) through U1362B and U1363B. The outputs from the A11 board (X+ and X-) drive the CRT horizontal amplifier inputs. When HDAC_EN is HI the currents in TIMEBASE+ and TIMEBASE- are added by U1362A and U1363A. The resulting current drives the Cursor/Readout horizontal deflection amplifier U1362C and D.

The Cursor/Readout horizontal deflection value is latched into U1360 by CR_PIXEL_CLK and drives the 8-bit Digital to analog Converter (DAC) U1361. The differential outputs of U1361 drive the amplifier U1362C and D.

The vertical deflection of the CRT can be either:

- NON-STORE mode trace deflection
- STORE mode trace deflection, or
- cursor/readout dot vertical deflection.

When STORE is HI (STORE mode) or CR_YDAC_EN is HI the vertical deflection of the CRT is driven from the vertical DAC amplifier U1373.

The STORE mode trace deflection value DRD[0..7] is latched into U1370 by END_PT.

The Cursor/Readout pixel vertical deflection value YDEF[0..7] is latched into U1371 by CR_PXL_CLK.

One of these deflection values is selected by CR_YDAC_EN (HI for Cursor/Readout, LO for STORE mode trace) which then drives the vertical deflection DAC U1372. The differential outputs of U1372 drive the vertical DAC amplifier U1373. The differential outputs of U1373 drive the CRT deflection amplifier.

Both the Horizontal and vertical DAC are converters with 8-bit resolution. To allow NON-STORE mode cursors to be positioned with 10-bit resolution (one part in 1024) the resistors R1354, R1357, R1384 and R1387 provide offsets of 0, 1/4, 1/2 and 3/4 of a least significant bit step to the horizontal and vertical DAC amplifiers.

The signal TEN_BIT_EN(L) enables U1365 which drives these resistors. The Cursor/Readout display RAM address bit CRDRA8 selects the offset values appropriate to the cursor being displayed. The CPU writes the offset values to U1364.

STORE MODE TIME CURSORS (diagram 35)

Part of the circuitry controlling the timing of STORE mode time cursors is situated on the Serial Interface board.

The display of STORE mode traces is paused at the points on the trace where the cursors intersect. This ensures that the CRT horizontal deflection value is correct for the display of a cursor attached to a sample point on the waveform (waveform cursor). The horizontal DAC amplifier is not enabled for STORE mode time cursors.

The Cursor/Readout CPU writes three 8-bit bytes of data to U1271, U1274 and U1275. These are passed as two 12-bit preload values to two 12-bit counters consisting of U1277, U1278, U1279 and U1280, U1281, U1282. These counters load these 12-bit values under the control of DISP_SYNC at the start of a STORE mode display cycle and count at the STORE mode trace display data rate. The ripple carry outputs of U1279 and U1282 go HI at fixed times during the STORE mode trace display cycles, once for each trace. This timing is defined by the data written into U1271, U1274 and U1275.

The signal WFC(L), which includes both ripple carry outputs, drives the Cursor/Readout display controller circuitry and the storage display timing circuitry. The Cursor/Readout display controller uses WFC(L) to start display of the segments of STORE mode time cursors. The storage display timing circuitry responds to WFC(L) going LO by starting a pause of about 100 microseconds in the display of STORE mode traces.

SERIAL INTERFACE PROCESSOR (diagram 33)

The serial interface CPU clock signal P_CLOCK is driven at 4.9152 MHz by the Cursor/Readout circuitry. The Cursor/Readout circuitry also provides a reset signal PWR_RST(L) which is LO for 0. 3s after power is applied to the 2211.

The Central Processing Unit (CPU) U1246 operates with the low order address bus time multiplexed with the data bus. U1252 separates the low order address bus SICPUA[0..7] from the data bus SICPUD[0..7]. The CPU generates a timing signal SICPUAS for this purpose.

ICs U1250 and U1251 decode address segments corresponding to physical addresses of the Serial Interface CPU memory locations and peripherals.

The CPU runs a fixed programme stored in the Read Only Memory (ROM) U1253. U1255 provides read/write data storage.

When the CPU address decode SIMAP0_3(L) is LO U1248 drives the logic levels of the six side-cup mounted parameter switches (LO for ON), the signal DRD_COPY and the synthetic display RAM address bit SDRA13 on to the Serial Interface CPU data bus SICPUD[0..7].

When the address decode SIMAP0_7(L) goes from LO to HI U1254 latches the four data bits SICPUD[0..3] to generate the signals SHRIGHT, REF_ENA, SHLEFT, CPUDTR and their respective logical complements. SHRIGHT, REF_ENA, and SHLEFT are used in the transfer of waveform status from the storage board to the serial interface board. CPUDTR is an RS232 handshaking signal.

HOST INTERFACE ‘SNAPSHOT’ LOGIC (diagram 32)

The ‘snapshot’ logic circuitry responds to a signal from the Serial Interface CPU by copying the STORE mode waveform and reference data into memory circuits. When the cycle is complete the data in the memory circuits can be read by the Serial Interface CPU.

When the address decode SIMAP0_2(L) goes LO the 4-bit counter U1210 loads binary count value 1010. The signal SNAPSHOT goes HI at this point.

The multiplexer U1214 controls the function of the counter chain U1220, U1222, U1224 and U1226. It switches the operating mode of the memories U1234 and U1236 between read and write.

When SNAPSHOT is LO the clock for the counter chain is derived from the storage display clock S_DISP_CLK. The counter chain is cleared by the storage system display synchronizing signal DISP_SYNC, so the counter chain tracks the storage display RAM address counter.

The storage display system data clock END_PT generates a write strobe via U1204, WRITE(L). When WRITE(L) is LO the storage system display data bus DRD[0..7] drives the snapshot memory data bus D[0..7]. When WRITE(L) goes HI the data are stored in the location defined by the address counter U1220, U1222, U1224 and U1226. As this counter cycles through the full address range of the storage display system data all four traces are copied into the display RAM.

U1210 count value increases until it reaches binary 1111, when the data copying process has been completed. At this point SNAPSHOT goes LO, and SNAPSHOT(L) goes HI.

When SNAPSHOT(L) is HI the counter chain U1220, U1222, U1224 and U1226 switches from count operation to parallel load operation. It acts as an address bus latch for the Serial Interface CPU address bus SICPUA[0..11], clocked by the Serial Interface CPU address strobe SICPUAS.

When the CPU address decodes SIMAP1(L) or SIMAP2(L) are LO the snapshot memory data bus

D[0..7] drives the CPU data bus SICPUD[0..7] through U1232.

The shift register U1216 is connected to a similar shift register in the storage system. They are arranged in a loop so that shift operation results in data circulation.

When the address decode SIMAP0_1(L) is LO, U1216 will either shift it's data contents, drive it's data contents onto the CPU data bus SICPUD[0..7] (read operation), or load data from the CPU data bus SICPUD[0..7] (write operation).

	SHLEFT	SHRIGHT
shift left	HI	LO
shift right	LO	HI
read	LO	LO
write	HI	HI

By a sequence of shift and read operations the CPU can read the sixteen data bits that define the status of the STORE mode waveform and reference displays.

RS-232 DRIVER AND RECEIVER (diagram 34)

The CPU circuitry drives three outputs (CPUTX, CPUDTR and CPURTS) and receives three inputs (CPURX, CPUDSR and CPUCTS) that are driven at logic circuit levels. The 2211 Serial Interface converts the outputs to RS-232 levels and receives the inputs at RS-232 levels using U1262 as the interface circuit.

U1263 converts 5. 1 volts DC into the +10 volt and -10 volt supplies required by U1262.

S1260 is a side-cup mounted momentary push button switch. If IPLOT(L) goes LO or S1260 is pushed then PLOT goes HI. The CPU can read the logic level of PLOT.

SHARED RAM (diagram 36)

The shared RAM circuit provides temporary data storage for both the Cursor/Readout CPU and the Serial Interface CPU, which provides the means for communicating data and control between the two processors.

The shared Ram circuit uses data and control signals from both the Cursor/Readout and Serial Interface processors.

The shared RAM is provided by U1292 with the associated gating circuitry U1260, U1273, U1289, U1290 and U1293 multiplexing the control signals to this RAM between the Cursor/Readout processor and the Serial Interface processor such that only one processor has access to the shared RAM at any one time.

U1286 demultiplexes the multiplexed address/data bus from the Cursor/Readout processor to synthesize the Cursor/Readout address bus SCRCPUA0. . SCRCPUA7 on the Serial Interface board. This address bus is then decoded by U1287 to generate memory mapped signals CR_RTC(L), CR_ASSERT(L), CR_RELEASE(L) and CR_REQUEST(L) to control the interface circuit to the shared RAM U1292. U1287 also decodes the control signals WC_PGM0, WC_PGM1 and WC_PGM2 for programming the position of store mode Delta-Time cursors.

Data is written and read from U1292 in a serial format. U1292/5 provides the serial input to the shared RAM with U1292/6 providing the serial output. The serial input data to the shared RAM is derived from the Cursor/Readout or Serial Interface Data bus Bit 7. The Serial output from the RAM is gated into the processors data bus Bit 0.

The function of the shared RAM is to allow the Serial Interface processor to interrogate the status of the Cursor/Readout system to determine the readout and cursor parameters required for the hardcopy plots. RTC_AVAIL is a bidirectional wired NOR handshake signal between the Cursor/Readout and Serial Interface processors. This signal is used to arbitrate access to the shared RAM thereby only allowing one processor to communicate with the shared RAM at any one time.

FUNCTIONAL DESCRIPTION OF 2211 CURSOR OPERATION

The rotary CURSORS control on the front panel is a dual ganged variable resistor with the wipers mechanically opposite. This ensures that at least one wiper will be in the linear region of the track.

As the control is rotated to move the cursors, the voltages on the wipers of R1308 change. These voltages are passed to the Cursor/Readout board (A11) through J1307. The signals are called CUR. POS. 1 and CUR. POS. 2 shown on diagram 41.

CUR. POS. 1 and CUR. POS. 2 are buffered by the two halves of U1350 and passed to the CMOS A/D converter U1341 channels 2 and 3 respectively.

The CPU (U1302) executes the fixed programme stored in U1305. This software will periodically call for conversion results from the A to D converter. A CPU cycle with Hexadecimal address in the range 0900 to 09FF will assert memory map decode CRMAP0_1(L). This will define channel selection (from the 3 least significant address bits) and initiate the conversion cycle. The signal CONV_CPLT goes LO to indicate that a conversion is in progress, then HI to indicate that it is complete. This signal is tested by the CPU.

A CPU read cycle with Hexadecimal address in the range 0A00 to 0AFF will assert memory map decode CPMAP0_1(L). This will read the conversion result from the A to D converter into the CPU. This read operation can only give a true result if the conversion cycle has been completed.

The CPU will respond to rotation of the cursor control by moving the cursors. This is done in one of two ways depending on the mode of cursor operation: STORE mode TIME cursors are controlled differently from STORE mode VOLTS cursors and NONSTORE mode cursors.

NONSTORE CURSORS AND STORE MODE VOLTS CURSORS

The cursor/readout display RAM U1315 stores a table of X, Y coordinates, see figure 3-10. Each coordinate is a number from 0 to 255 which defines a horizontal or vertical deflection value. These pairs of 8-bit data bytes are a list of all the bright dots in the cursor/readout display.

The Readout characters and the Cursors consist of patterns of bright dots on the CRT display. The X and Y co-ordinates are read from U1315 into the Vertical and Horizontal DAC circuits which drive the CRT beam to the required location on the CRT display. A change in the data stored in U1315 will result in a change in the CRT cursor/readout display.

The CPU responds to the rotation of the front panel CURSORS control by changing the data stored in U1315. To move TIME cursors horizontally the X coordinates are increased or decreased. To move VOLTS cursors vertically the Y co-ordinates are increased or decreased.

The CPU has write-only access to U1315 during the time that CPU_W_E is HI. A CPU write cycle with Hexadecimal address in the range 1000 to 1FFF will assert memory map decode CPMAP1(L) which starts a write operation from the CPU data bus into the memory U1315.

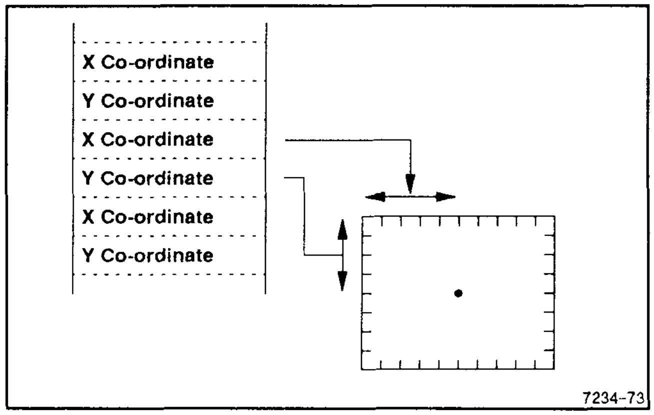


Figure 3-10. U1315 memory contents.

The organization of data in U1315 is important. The first 512 bytes of the memory hold the deflection values for the cursors. Space exists for 254 bright dots to be listed, but not all of these are used. The memory locations lower than address 512 not required for cursor display have data values Hexadecimal FF stored in the Y deflection location which signals to the display controller that the intensity should be switched off.

The remainder of U1315 holds the deflection values for the onscreen parameter readout. The last pair of deflection values is followed by data pair hexadecimal FF, FF. This indicates to the display controller that the CRT display refresh is complete.

The display controller has read-only access to U1315 when CPU_W_E is LO.

The array of counters U1310, U1311, U1312, U1313 act as memory address latch for CPU write operations into U1315. The counters U1311, U1312, U1313 act as address counter for display controller read operations from U1315.

The display controller reads pairs of bytes (X and Y deflections) from successive memory locations in U1315 and stores them in the horizontal and vertical DAC latches.

When CR_YDAC_EN is HI the vertical deflection value held in the vertical DAC latch U1371 is passed through the vertical DAC U1372 and the amplifier U1373 to the vertical deflection amplifier on the A1 board. The amplifier U1373 is enabled by the STORE signal or the CR_YDAC_EN signal.

The signal HDAC_EN controls the horizontal multiplexer circuit U1362/U1363. This signal is the same as CR_YDAC_EN except in STORE mode TIME cursors.

When HDAC_EN is HI the horizontal deflection source selected is the horizontal DAC output.

FINE CONTROL OF NONSTORE CURSORS

The resolution of the vertical and horizontal DAC circuits (U1361 and U1372) is eight bits. The smallest cursor movement that the DACs can generate is 1/25th division.

The latch U1364 and multiplexer U1365 control the fine movement of the NONSTORE cursors in steps of 1/100th division. The CPU has write-only access to U1364. A CPU write cycle with Hexadecimal address in the range 0E00 to 0EFF will assert memory map decode CPMAP0_6(L), which will latch the data from the CPU data bus into U1364.

STORE MODE TIME CURSORS

The vertical deflection values for STORE mode time cursors are defined in exactly the same way as for the other cursor modes. U1315 holds a table of pairs of deflection values defining bright dot positions on the CRT display.

The data corresponding to cursor dot locations is stored in different memory addresses than for the other cursor modes. The data stored for cursor dot locations does not include the horizontal deflection values, only the vertical deflection values.

The CPU reads the conversion result from U1341 and responds to CURSORS control rotation by writing data to latches U1271, U1274 and U1275 ON THE SERIAL INTERFACE BOARD, A21. A CPU write cycle with Hexadecimal address in the range 0A00 to 0AFF will assert memory map decode CPMAP0_1(L) generated by U1307 on the cursor/readout board. This enables memory map decoder U1287 on the serial interface board. The three low order address bits CRCPUA0, CRCPUA1 and CRCPUA2 select the active output of U1287. The outputs WC_PGM0, WC_PGM_1 and WC_PGM2 select write operations into U1271, U1274 and U1275 respectively. The data bytes written into these latches form two twelve-bit data words that are loaded into two twelve-bit counters as count start values.

These two twelve-bit counters (U1277, U1278, U1279, U1280, U1281 and U1282) are clocked at the same rate as the storage system display address counter U2001 on the storage board A10. The clock signal is the display clock DISP_CLK passed through noise reduction buffering circuits. The counters receive a parallel load signal from the storage display synchronizing signal DISP_SYNC. This signal latches the two twelve bit start values into the counters. The counters count at the same rate as the CRT display of the individual samples of the stored waveforms. The counters will reach their terminal count value (hexadecimal FFF) at a time dependent on the start values. When the counters reach FFF the ripple-carry output is asserted causing WFC(L) to be asserted. The timing of this signal will be controlled by the data written to the latches U1271, U1274 and U1275, which is determined by the processor.

The pulses on WFC(L) last for 1 microsecond. There are two pulses for each waveform display period (5 ms). The pulses are present whether individual traces are displayed or not. The timing of the pulses relative to the STORE mode waveform display cycle is determined by the CPU and can be varied by rotating the front panel CURSORS control.

The signal WFC(L) is connected via W1302 wire number 18 to the cursor/readout board A11 and the storage board A10.

On the storage board A10 WFC(L) connects to the Display RAM Address counter U2001. When WFC(L) is asserted LO the output TP/WFC will be asserted HI on the next display clock cycle. The signal TP/WFC is synchronized by U2008 and the signal TP/WFC_S connects to the Display States controller U2261.

The Display States controller responds to TP/WFC_S by pausing the waveform display process for a period of time controlled by the Trigger Point and Waveform Cursor Dwell monostable U2257B. This pause allows the cursor/readout display controller time to display a portion (one third) of one of the STORE mode time cursors.

On the Cursor/Readout board A11 the signal WFC(L) connects to U1369 which is clocked at the same rate as U2001 on the storage board. When WFC(L) is asserted LO the output ST_CR(L) will be asserted LO on the next display clock cycle. This will start the Dot Display Controller U1320 reading CRT display dot coordinates from the cursor/readout display RAM U1315.

The Cursor/Readout display controller will read X and Y coordinates from U1315. CR_YDAC_EN will be asserted to allow the vertical DAC to drive the CRT deflection. U1369 will prevent HDAC_EN being asserted so the horizontal deflection will be controlled by the STORE mode sweep. This will result in vertical time cursors being drawn at a horizontal position on the screen that is defined by the timing of the WFC(L) pulses and the STORE mode sweep. This cursor mode is called Waveform Cursors. Note that the horizontal DAC does not affect the display of waveform cursors.

When the last cursor dot in a cursor segment has been displayed CR_YDAC_EN goes LO so that the vertical deflection switches back to the STORE mode waveform for the rest of the waveform display pause. This results in a bright dot on the displayed waveforms at the point where the waveform cursors are attached.

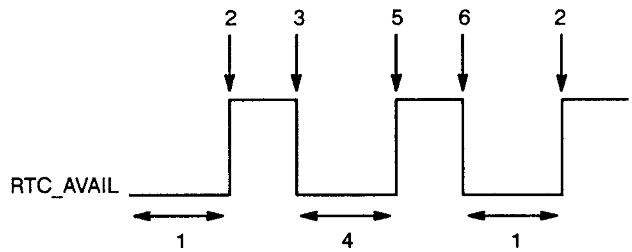
During the time allocated to the display of REF2 the cursor/readout display controller does not display cursors, whether REF2 display is selected or not. The signal CPU_W_E is asserted HI to indicate that the CPU has write only access to the cursor/readout display RAM U1315.

Summarizing—the CPU on the A11 board detects CURSORS control rotation and writes counter offsets to the registers on the A21 board. The counters on the A21 board generate pulses that start a waveform display dwell on the A10 board and start display of waveform cursor segments on the A11 board. The vertical deflection of the waveform cursor bright dots is defined in U1315, and the horizontal deflection of the cursors is defined by the horizontal sweep and counter offset values.

DATA/CONTROL FLOW WHEN A PRINT/PLOT IS REQUESTED

When a print/plot is requested, the serial interface processor performs communication with the Cursor/Readout board (A11 board) to obtain information relating to the cursor positions, cursor type and other readout information. Communication with the Storage Board (A10 board) then takes place in order to acquire the waveform data. Only after the cursor, readout and waveform data is obtained does the serial interface processor format this data and transmit it across the RS232 interface to printers/plotters to generate the hardcopy representation of the screen contents.

A plot is requested either by the print/plot switch being depressed or pin 9 of connector P1295 being grounded, either of these causing the signal PB(L) to be asserted. The serial interface processor U1246 pin 14 detects this request and initiates communication with the Cursor/Readout processor U1302 using the RTC_AVAIL signal. RTC_AVAIL is a wired NOR signal which is normally pulled low by U1246 and monitored by the Cursor/Readout processor. This signal provides the means for controlling the handshaking of data between the processors. The interprocessor activity that transfers the Cursor/Readout information to the serial interface is related to the state of RTC_AVAIL as shown below :



1. This is the normal State with Serial Interface processor having control of shared RAM and driving the RTC_AVAIL line low.
2. When a print/plot is requested the serial interface processor releases RTC_Avail, i.e., requesting information from Cursor/Readout processor.
3. Cursor/Readout processor detects RTC_Avail High and pulls it low to take control of shared RAM.
4. Cursor/Readout processor writes status information into the shared RAM.
5. Cursor/Readout processor release RTC_Avail on completion of writing data to the shared RAM.
6. Serial Interface processor detects that RTC_Avail has been released by the Cursor/Readout processor and pulls it low to take control of the shared RAM.

On completion of the above handshaking sequence the Serial interface processor obtains the waveform record data from the storage board (A10) using the 'Snapshot' circuit on the serial interface board as described below:

The 'snapshot' logic circuitry responds to a signal from the Serial Interface CPU by copying the STORE mode waveform and reference data into memory circuits. When the cycle is complete the data in the memory circuits can be read by the Serial Interface CPU.

When the address decode SIMAP0_2(L) goes LO the 4-bit counter U1210 loads binary count value 1010. The signal SNAPSHOT goes HI at this point.

The multiplexer U1214 controls the function of the counter chain U1220, U1222, U1224 and U1226. It switches the operating mode of the memories U1234 and U1236 between read and write.

When SNAPSHOT is LO the clock for the counter chain is derived from the storage display clock S_DISP_CLK.

The counter chain is cleared by the storage system display synchronizing signal DISP_SYNC, so the counter chain tracks the storage display RAM address counter.

The storage display system data clock END_PT generates a write strobe via U1204, WRITE(L). When WRITE(L) is LO the storage system display data bus DRD[0..7] drives the snapshot memory data bus D[0..7]. When WRITE(L) goes HI the data are stored in the location defined by the address counter U1220, U1222, U1224 and U1226. As this counter cycles through the full address range of the storage display system data all four traces are copied into the display RAM.

U1210 count value increases until it reaches binary 1111, when the data copying process has been completed. At this point SNAPSHOT goes LO, and SNAPSHOT(L) goes HI.

When SNAPSHOT(L) is HI the counter chain U1220, U1222, U1224 and U1226 switches from count operation to parallel load operation. It acts as an address bus latch for the Serial Interface CPU address bus SICPUA[0..11], clocked by the Serial Interface CPU address strobe SICPUAS.

When the CPU address decodes SIMAP1(L) or SIMAP2(L) are LO the snapshot memory data bus D[0..7] drives the CPU data bus SICPUD[0..7] through U1232.

The serial interface processor now uses the shift register U1216 to obtain information relating to which channels are displayed on the CRT and the location of the trigger points for each waveform.

The shift register U1216 is connected to a similar shift register in the storage system. They are arranged in a loop so that shift operation results in data circulation.

By a sequence of shift and read operations the CPU can read the seventeen data bits that define the status of the STORE mode waveform and reference displays.

The sequence of shift operations are controlled using the signals SHLEFT, SHRIGHT and SHRIGHT(L) derived from latch U1254. The shift register loop is clocked by memory map decode SIMAP0_1(L). Four shift modes are selectable by the serial interface processor and described in the table below:

Shift Mode	SHLEFTP	SHRIGHT
Shift Left	HI	LO
Shift Right	LO	HI
Shift Off	LO	LO
Shift Write	HI	HI

When the address decode SIMAP0_1(L) is LO U1216 will either shift it's data contents, drive it's data contents onto the CPU data bus SICPUD[0..7] (read operation) or load data from the CPU data bus SICPUD[0..7] (write operation).

The signals DRD_COPY and SDRA13 are read by the serial interface processor and used to synchronize the shift operations described above to the storage system display. This is necessary because the shift operations temporarily destroy the reference status information and hence the display would be unpredictable if the shift operation and the reference channel display were concurrent.

The sequence of shift operations is outlined below:

- The serial interface processor waits for the signal DRD_Copy to be asserted.
- The serial interface processor waits for the signal SDRA13 to be low (i.,e., storage system is not displaying reference waveforms).
- The shift mode is set to 'Shift Right' (see table above).
- Memory map decode SIMAP0_1(L) is clocked 8 times to transfer the storage reference status from U2003 (A10 board) into U1216 (A21 board).
- The shift mode is set to 'Shift Off'.
- SIMAP0_1(L) is clocked once to read the reference status from U1216 into the serial interface processor.
- The shift mode is set to 'Shift Left'
- SIMAP0_L is clocked once to transfer the Ref_On signal into U2003.
- The shift mode is set to 'Shift Right'
- SIMAP0_L is clocked once to transfer the Ref_On signal state into U1216.
- The shift mode is set to 'Shift Off'.

- SIMAP0_1(L) is clocked once to read the state of the Ref_On signal from U1216 into the serial interface processor.
- The shift mode is set to 'Shift Load'
- SIMAP0_1(L) is clocked once to write the previously stored acquisition status back into U1216.
- The shift mode is set to 'Shift Off'.
- SIMAP0_1(L) is clocked once to transfer the acquisition status from U2002 (A10 board) to U2003 (A10 board).
- The shift mode is set to 'Shift Right'.
- Memory map decode SIMAP0_L is clocked 8 times to transfer the storage acquisition status from U2003 (A10 board) into U1216 (A21 board).
- The shift mode is set to 'Shift Off'.
- The serial interface processor waits for the signal SDRA13 to be high.
- The serial interface processor reads and the acquisition status from U1216.

On completion of the above shift register operations the serial interface processor has the information it requires to generate the HP-GL or Epson graphics compatible data that is transmitted across the RS232 interface.

The RS232 data timing is derived directly from the processor clock P_CLOCK with the data and handshake signals being generated by the serial interface microprocessor. The transmitted data is generated from pin 12 of U1245. This processor also monitors the two hardware handshake signal CPUDSR and CPUCTS. If hardware handshake is selected (see description of interface parameter selection using side panel Dip-Switch settings) data is only transmitted if both CPUDSR and CPUCTS are low. If software handshake is enabled, data is transmitted until a particular character (XOFF) is received via CPURX (U1245 pin 11).

If the handshaking is operating correctly, the serial interface processor will transmit data until the complete screen representation has been generated or the print/plot push button is depressed for more than 3 seconds while a plot is in progress.

PERFORMANCE CHECK PROCEDURE

INTRODUCTION

PURPOSE

The "Performance Check Procedure" is used to verify the instrument's Performance Requirements statements listed in Table 1-1 and to determine the need for calibration. The performance checks may also be used as an acceptance test or as a preliminary troubleshooting aid.

PERFORMANCE CHECK INTERVAL

To ensure instrument accuracy, check its performance after every 2000 hours of operation or once each year, if used infrequently. A more frequent interval may be necessary if the instrument is subjected to harsh environments or severe usage.

STRUCTURE

The "Performance Check Procedure" is structured in subsections to permit checking individual sections of the instrument whenever a complete Performance Check is not required. At the beginning of each subsection there is an equipment-required list showing only the test equipment necessary for performing the steps in that subsection. In this list, the Item number that follows each piece of equipment corresponds to the Item number listed in Table 4-1.

Also at the beginning of each subsection is a list of all the front-panel control settings required to prepare the instrument for performing Step 1 in that subsection. Each succeeding step within a particular subsection should then be performed, both in the sequence presented and in its entirety, to ensure that control-setting changes will be correct for ensuing steps.

TEST EQUIPMENT REQUIRED

The test equipment listed in Table 4-1 is a complete list of the equipment required to accomplish both the "Performance Check Procedure" in this section and the "Adjustment Procedure" in Section 5. Test equipment specifications described in Table 4-1 are the minimum necessary to provide accurate results. Therefore, equipment used must meet or exceed the listed specifications. Detailed operating instructions for test equipment are not given in this procedure. If more operating information is required, refer to the appropriate test equipment instruction manual.

When equipment other than that recommended is used, control settings of the test setup may need to be altered. If the exact item of equipment given as an example in Table 4-1 is not available, check the "Minimum Specification" column to determine if any other available test equipment might suffice to perform the check or adjustment.

LIMITS AND TOLERANCES

The limits and tolerances given in this procedure are valid for an instrument that is operating in and has been previously calibrated in an ambient temperature between +20°C and 30°C. The instrument also must have had at least a 20-minute warm-up period. Refer to Table 1-1 for tolerances applicable to an instrument that is operating outside this temperature range. All tolerances specified are for the instrument only and do not include test-equipment error.

PREPARATION FOR CHECKS

It is not necessary to remove the instrument cover to accomplish any subsection in the "Performance Check Procedure," since all checks are made using operator-accessible front- and rear-panel controls and connectors.

The most accurate display adjustments are made with a stable, well-focused, low-intensity display. Unless otherwise noted, adjust the INTENSITY, FOCUS, and Trigger LEVEL controls as needed to view the display.

Table 4-1
Test Equipment Required

Item and Description	Minimum Specification	Purpose	Example of Suitable Test Equipment
1. Calibration Generator	Standard-amplitude signal levels: 5 mV to 50 V. Accuracy: ±0.3%. High-amplitude signal levels: 1 V to 60 V. Repetition rate: 1 kHz. Fast-rise signal level: 1 V. Repetition rate: 1 MHz. Rise time: 1 ns or less. Flatness: ±0.5%.	Signal source for gain and transient response checks and adjustments.	TEKTRONIX PG 506A Calibration Generator. [a]
2. Leveled Sine-Wave Generator	Frequency: 250 kHz to above 50 MHz. Output amplitude: variable from 10 mV to 5 V p-p. Output impedance: 50 Ω. Reference frequency: 50 kHz. Amplitude accuracy: constant within 3% of reference frequency as output frequency changes.	Vertical, horizontal, and triggering checks and adjustments. Display adjustments and Z-Axis check.	TEKTRONIX SG 503 Leveled Sine-Wave Generator. [a]
3. Time-Mark Generator	Marker outputs: 10 ns to 0.5 s. Marker accuracy: ±0.1%. Trigger output: 1 ms to 0.1 μs, time-coincident with markers.	Horizontal checks and adjustments. Display adjustment.	TEKTRONIX TG 501A Time-Mark Generator. [a]
4. Low-Frequency Sine-Wave Generator	Range: 10 kHz to 500 kHz. Output amplitude: 300 mV. Output impedance: 600 Ω. Reference frequency: constant within 0.3 dB of reference frequency as output frequency changes.	Low-frequency trigger checks.	TEKTRONIX SG 502 Oscillator.[a]
5. Pulse Generator	Output: high and low levels independently adjustable over a -5 V to +5 V range. Minimum amplitude: less than or equal to 0.5 V p-p. Maximum amplitude: greater than or equal to 5 V p-p. Amplitude accuracy: less than or equal to ±5% at 5 V p-p amplitude.	Signal source for Storage board external clock checks.	TEKTRONIX PG 502 250 MHz Pulse Generator. [a]
6. Screwdriver	Length: 3 inch shaft Bit size: 3/32 inch	Adjust variable resistors.	Xcelite R-3323.
7. Test Oscilloscope	Bandwidth: dc to 100 MHz. Minimum deflection factor: 5 mV/div. Accuracy: ±3%.	General troubleshooting.	TEKTRONIX 2235 Oscilloscope.
8. Digital Voltmeter (DMM)	Range: 0 to 140 V. Dc voltage accuracy: ±0.15%, 4½-digit display.	Power supply checks and adjustments.	TEKTRONIX DM 511 Digital Multimeter.[a]
9. Coaxial Cables	Impedance: 50 Ω. Length: 42 in. Connectors: BNC.	Signal interconnection.	Tektronix Part Number 012-0057-01.

[a] **Requires a TM 500-Series Power Module.**

Table 4-1 (cont)

Item and Description	Minimum Specification	Purpose	Example of Suitable Test Equipment
10. Dual-Input Coupler	Connectors: BNC female-to-dual-BNC male.	Signal interconnection.	Tektronix Part Number 067-0525-01.
11. Termination	Impedance: 50 Ω Connectors: BNC.	Signal termination.	Tektronix Part Number 011-0049-01.
12. Termination	Impedance: 600 Ω Connectors: BNC.	Signal termination.	Tektronix Part Number 011-0092-00.
13. 10X Attenuator	Ratio: 10X. Impedance: 50 Ω. Connectors: BNC.	Vertical compensation and triggering checks.	Tektronix Part Number 011-0059-02.
14. Adapter	Connectors: BNC male-to-miniature-probe tip.	Signal interconnection.	Tektronix Part Number 013-0084-02.
15. Adapter	Connectors: BNC male-to-tip plug.	Signal interconnection.	Tektronix Part Number 175-1178-00.
16. Low-Reactance Alignment Tool	Length: 1-in. shaft. Bit size: 3/32 in.	Adjust variable capacitors.	J.F.D. Electronics Corp. Adjustment Tool Number 5284.
17. GRABBER Disk		Test serial interface.	Tektronix Part Number 119-3566-01.
18. Interface Cable		Signal interconnection	Tektronix Part Number 012-1197-00.
19. IBM-Compatible PC	Serial interface.	Test serial interface.	

INDEX TO PERFORMANCE CHECK STEPS

Vertical

Horizontal

Trigger

External Z-Axis and Probe Adjust

Storage

Cursors and Readout

Serial Interface

VERTICAL

Equipment Required (See Table 4-1):

Calibration Generator (Item 1)
Leveled Sine-Wave Generator (Item 2)
50-Ω BNC Coaxial Cable (Item 9)
Dual-Input Coupler (Item 10)
50-Ω BNC Termination (Item11)
10X BNC Attenuator (Item 13)
BNC Male-to-Miniature-Probe Tip (Item 14)

INITIAL CONTROL SETTINGS

Vertical

POSITION (both)	Midrange
MODE	CH 1, NORM
VOLTS/DIV (both)	5 mV
VOLTS/DIV Variable (both)	CAL detent
Magnification	X1 (CAL knobs in)
AC-GND-DC	DC

Horizontal

POSITION (COARSE and FINE)	Midrange
MAG	X1
SEC/DIV	0.5 ms
SEC/DIV Variable	CAL detent

Trigger

SLOPE	Positive (up)
LEVEL	Midrange
MODE	P-P AUTO
HOLDOFF	MIN
SOURCE	VERT MODE
COUPLING	DC

Storage

STORE/NON-STORE	NON-STORE (button out)

PROCEDURE STEPS

1. Check Deflection Accuracy and Variable Range

a. Connect a 20 mV standard-amplitude signal from the calibration generator via a 50-Ω BNC cable to the CH 1 OR X input connector.

b. CHECK—deflection accuracy is within the limits given in Table 4-2 for each CH 1 VOLTS/DIV switch setting and corresponding standard-amplitude signal. When at the 20 mV VOLTS/DIV switch setting, rotate the CH 1 VOLTS/DIV Variable control fully counterclockwise and check that the display decreases to two divisions or less. Then return the CH 1 VOLTS/DIV Variable control to the CAL detent and continue with the 50 mV check.

c. Set the calibration generator to output 2 V.

d. Set the CH 1 vertical magnification to X10 (pull CAL knob out)

e. CHECK—X10 MAG deflection accuracy is within the limits given in Table 4-2 for each VOLTS/DIV switch setting and corresponding standard amplitude signal in reverse order, starting at 5 V per division (0.5 V per division in X10 magnified).

f. Move the cable from the CH 1 OR X input connector to the CH 2 OR Y input connector. Set the Vertical MODE switch to CH 2.

g. Set the calibration generator to output 20 mV.

h. Repeat parts b through e using the Channel 2 controls.

Table 4-2
Deflection Accuracy Limits

VOLTS/DIV Switch Setting		Standard Amplitude Signal		Accuracy Limits (Divisions)	
X1	X10	X1	X10	X1	X10
5 mV	0.5 mV	20 mV	2 mV	3.88 to 4.12	3.8 to 4.2
10 mV	1 mV	50 mV	5 mV	4.85 to 5.15	4.75 to 5.25
20 mV	2 mV	0.1 V	10 mV	4.85 to 5.15	4.75 to 5.25
50 mV	5 mV	0.2 V	20 mV	3.88 to 4.12	3.8 to 4.2
0.1 V	10 mV	0.5 V	50 mV	4.85 to 5.15	4.75 to 5.25
0.2 V	20 mV	1 V	0.1 V	4.85 to 5.15	4.75 to 5.25
0.5 V	50 mV	2 V	0.2 V	3.88 to 4.12	3.8 to 4.2
1 V	0.1 V	5 V	0.5 V	4.85 to 5.15	4.75 to 5.25
2 V	0.2 V	10 V	1 V	4.85 to 5.15	4.75 to 5.25
5 V	0.5 V	20 V	2 V	3.88 to 4.12	3.8 to 4.2

2. Check Position Range

a. Set:

VOLTS/DIV (both)	10 mV
AC-GND-DC (both)	AC
SEC/DIV	0.2 ms

b. Set the calibration generator to output 0.1 V.

c. Adjust the CH 2 VOLTS/DIV Variable control to produce a 5.25-division display.

d. Set CH 2 VOLTS/DIV to 5 mV.

e. Set the calibration generator to produce a 0.2 V signal.

f. CHECK—the bottom and top of the trace may be positioned above and below the center horizontal graticule line by rotating the Channel 2 POSITION control fully clockwise and counterclockwise respectively.

g. Move the cable from the CH 2 OR Y input connector to the CH 1 OR X input connector.

h. Set the Vertical MODE switch to CH 1.

i. Repeat parts b through e using the Channel 1 controls.

j. Return both VOLTS/DIV Variable knobs to their detent positions.

k. Disconnect the test equipment from the instrument.

3. Check High Frequency Compensation

a. Set:

AC-GND-DC (both)	DC
SEC/DIV	0.2 μs
Horizontal MAG	X1
Trigger SOURCE	VERT MODE

b. Connect the positive-going fast-rise square wave output of the calibration generator via a 50-Ω BNC coaxial cable, a 10X BNC attenuator, and a 50-Ω BNC termination to the CH 1 OR X input connector.

c. Set the generator to produce a 1 MHz, five-division display.

d. Position the bottom of the display to the bottom horizontal graticule line using the CH 1 POSITION control and position the leading edge of a pulse on the center vertical graticule line.

e. CHECK—for aberrations at the top of the waveform of ±6% (0.3 division) or less.

f. Set CH 1 VOLTS/DIV to 10 mV.

g. Set the generator to produce a 1 MHz, five-division display.

h. CHECK—or aberrations ±4% (0.2 division) or less.

i. Repeat parts g and h for each of the following CH 1 VOLTS/DIV switch settings: 20 mV through 0.2 V. Adjust the generator output and add or remove the 10X attenuator as necessary to maintain a five-division display at each VOLTS/DIV switch setting.

j. Move the cable from the CH 1 OR X input connector to the CH 2 OR Y input connector. Set the Vertical MODE switch to CH 2.

k. Repeat parts c through i for Channel 2.

l. Disconnect the test equipment from the instrument.

4. Check Bandwidth

a. Set:

VOLTS/DIV (both)	5 mV
Vertical MODE	CH 1
SEC/DIV	10 μs

b. Connect the leveled sine-wave generator output via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input connector.

c. Set the generator to produce a 50 kHz, six-division display.

d. Increase the signal frequency until a 4.2 division display is obtained.

e. CHECK—that the frequency is greater than 50 MHz.

f. Repeat parts c through e for all VOLTS/DIV setting from 10 mV to 1 V

NOTE

For the 1-V-per-division VOLTS/DIV setting, use a five-division display of the 50-kHz reference frequency; use 3.5 divisions peak-to-peak as the -3 dB reference point of the bandwidth.

g. Set:

CH 1 VOLTS/DIV	5 mV
CH1 Vertical Magnification	X10 (pull CH 1 CAL knob out)

h. Set the generator to produce a 50 kHz, six-division display.

i. Increase the signal frequency until a 4.2 division display is obtained.

j. CHECK—that the frequency is greater than 5 MHz.

k. Repeat parts h through j for all ranges from 10 mV to 0.2 V.

l. Set the CH 1 Vertical Magnification to X1 (push CAL knob in).

m. Set Vertical MODE to CH 2.

n. Repeat parts b through l for CH 2 using the CH 2 controls.

5. Check Channel Isolation

a. Set:

VOLTS/DIV (both)	0.5 V
AC-GND-DC (CH 1)	GND
SEC/DIV	0.05 μs

b. Set the generator to produce a 10 MHz, five-division display.

c. Set Vertical MODE to CH 1.

d. CHECK—that the display amplitude is less than 0.1 division.

e. Move the test-signal cable from the CH 2 OR Y input connector to the CH 1 OR X input connector.

f. Set:

Vertical MODE	CH 2
CH 2 AC-GND-DC	GND
CH 1 AC-GND-DC	DC

g. CHECK—that the display amplitude is less than 0.1 division.

h. Disconnect the test equipment from the instrument.

6. Check Common Mode Rejection Ratio

a. Set:

VOLTS/DIV (both)	10 mV
AC-GND-DC (both)	DC

b. Connect the leveled sine-wave generator output via a 50-Ω BNC coaxial cable, a 50-Ω BNC termination, and dual-input coupler to the CH 1 OR X and CH 2 OR Y input connectors.

c. Set the generator to produce a 20 MHz, five-division display.

d. Set:

Vertical MODE	BOTH, INVERT and ADD.

e. CHECK—that the ADD trace is 0.6 division or less.

f. Disconnect the test equipment from the instrument.

HORIZONTAL

Equipment Required (See Table 4-1):

Calibration Generator (Item 1)	Test Oscilloscope (Item 7)
Leveled Sine-Wave Generator (Item 2)	50-Ω Coaxial Cable (Item 9)
Time-Mark Generator (Item 3)	50-Ω BNC Termination (Item 11)

INITIAL CONTROL SETTINGS

Vertical

POSITION (both)	Midrange
MODE	CH 1, NORM
VOLTS/DIV (both)	0.5 V
VOLTS/DIV Variable (both)	CAL detent
Magnification (both)	X1 (CAL knobs in)
AC-GND-DC (both)	DC

Horizontal

POSITION (COARSE and FINE)	Midrange
MAG	X1
SEC/DIV	0.05 μs
SEC/DIV Variable	CAL detent

Trigger

SLOPE	Positive (up)
LEVEL	Midrange
MODE	P-P AUTO
HOLDOFF	MIN
SOURCE	CH 1
COUPLING	AC

Storage

STORE/NON-STORE	NON-STORE (button out)

PROCEDURE STEPS

1. Check Timing Accuracy and Linearity

a. Connect 50 ns time markers from the time-mark generator via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input connector.

b. Adjust the Trigger LEVEL control for a stable, triggered display.

c. Use the Horizontal POSITION controls to align the second time marker with the second vertical graticule line.

d. CHECK—timing accuracy is within 3% (0.24 division at the tenth vertical graticule line), and linearity is within 5% (0.10 division over any two of the center eight divisions).

NOTE

For checking the timing accuracy of the SEC/DIV switch settings from 50 ms to 0.5 s, watch the time marker tips only at the second and tenth vertical graticule lines while adjusting the Horizontal POSITION controls to line up the time makers.

e. Repeat parts b through d for the remaining SEC/DIV and time-mark generator setting combinations shown in Table 4-3 under the "Normal" column.

NOTE

In X50 magnification in all "2" decade switch settings, the associated time marker settings give only five markers per ten divisions instead of the customary 10. When checking these ranges, position the markers on the second and ninth vertical graticule lines.

f. Set:

SEC/DIV	0.1 μs
Horizontal MAG	X10

g. Select 10 ns time markers from the time-marker generator.

Table 4-3

Settings for Timing Accuracy Checks

SEC/DIV Switch Setting	Time-Mark Generator Setting		
	Normal	X10 Mag	X50 Mag
0.05 μs	50 ns	5 ns	
0.1 μs	0.1 μs	10 ns	
0.2 μs	0.2 μs	20 ns	
0.5 μs	0.5 μs	50 ns	10 ns
1 μs	1 μs	0.1 μs	20 ns
2 μs	2 μs	0.2 μs	0.1 μs
5 μs	5 μs	0.5 μs	0.1 μs
10 μs	10 μs	1 μs	0.2 μs
20 μs	20 μs	2 μs	1 μs
50 μs	50 μs	5 μs	1 μs
0.1 ms	0.1 ms	10 μs	2 μs
0.2 ms	0.2 ms	20 μs	10 μs
0.5 ms	0.5 ms	50 μs	10 μs
1 ms	1 ms	0.1 ms	20 μs
2 ms	2 ms	0.2 ms	0.1 ms
5 ms	5 ms	0.5 ms	0.1 ms
10 ms	10 ms	1 ms	0.2 ms
20 ms	20 ms	2 ms	1 ms
50 ms	50 ms	5 ms	1 ms
0.1 s	0.1 s	10 ms	2 ms
0.2 s	0.2 s	20 ms	10 ms
0.5 s	0.5 s	50 ms	10 ms

h. Use the Horizontal POSITION controls to align the first time marker that is 50 ns beyond the start of the sweep with the second vertical graticule line.

i. CHECK—timing accuracy is within 4% (0.32 division at the tenth vertical graticule line), and linearity is within 7% (0.14 division over any two of the center eight divisions). Exclude any portion of the sweep past the 50th magnified division.

j. Repeat parts h and i for the remaining SEC/DIV and time-mark generator setting combinations shown in Table 4-3 under the X10 Mag column.

k. Set:

SEC/DIV	0.5 μs
Horizontal MAG	X50

l. Select 10 ns time markers from the time-marker generator.

m. Use the Horizontal POSITION controls to align the first time marker that is 100 ns beyond the start of the sweep with the second vertical graticule line.

n. CHECK—timing accuracy is within 5% (0.40 division at the tenth vertical graticule line), and linearity is within 9% (0.18 division over any two of the center eight divisions). Exclude any portion of the sweep past the 100th magnified division.

o. Repeat parts m and n for the remaining SEC/DIV and time-mark generator setting combinations shown in Table 4-3 under the X50 Mag column.

2. Check Sweep Length

a. Set:

SEC/DIV	0.1 ms
Horizontal MAG	X1

b. Select 0.1 ms time markers from the time-mark generator.

c. Position the start of the sweep at the first vertical graticule line using the Horizontal POSITION controls.

d. CHECK—that the sweep length is between 10.2 and 12 divisions.

3. Check COARSE and FINE Horizontal Position Range

a. CHECK—that the start of the sweep can be positioned to the right of the center vertical graticule line by rotating the COARSE Horizontal POSITION control fully clockwise.

b. CHECK—that the tenth time marker can be positioned to the left of the center vertical graticule line by rotating the COARSE Horizontal POSITION control fully counterclockwise.

c. CHECK—that the FINE Horizontal POSITION control can move the trace more than 0.4 divisions.

4. Check SEC/DIV Variable Range

a. Select 0.5 ms time markers from the time-mark generator.

b. Set the SEC/DIV Variable control fully counter-clockwise.

c. CHECK—that the spacing between time markers is two divisions or less.

d. Return the SEC/DIV Variable to the CAL detent position.

e. Disconnect the test equipment from the instrument.

5. Check X Gain

a. Set:

VOLTS/DIV (both)	10 mV
SEC/DIV	X-Y (fully counter clockwise)

b. Connect 50 mV standard amplitude signal from the calibration generator via a 50-Ω BNC coaxial cable to the CH 1 OR X input connector.

c. CHECK—the display is between 4.85 and 5.15 divisions.

d. Disconnect the test equipment from the instrument.

6. Check X Bandwidth

a. Set both channels VOLTS/DIV switches to 50 mV.

b. Connect the leveled sine-wave generator output via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input connector.

c. Set the generator to produce a eight-division horizontal display at an output frequency of 50 kHz.

d. Increase the generator output frequency until the X-Axis (horizontal) deflection amplitude is 5.7 divisions.

e. CHECK—that the generator frequency is 2 MHz or greater.

f. Disconnect the test equipment from the instrument.

TRIGGER

Equipment Required (See Table 4-1):

- Calibration Generator (Item 1)
- Leveled Sine-Wave Generator (Item 2)
- Low-Frequency Sine-Wave Generator (Item 4)
- 50-Ω BNC Coaxial Cable (Item 9)
- Dual-Input Coupler (Item 10)
- 50-Ω BNC Termination (Item 11)
- 600-Ω BNC Termination (Item 12)

INITIAL CONTROL SETTINGS

Vertical

POSITION	Midrange
MODE	CH 1
CH 1 VOLTS/DIV	0.1 V
CH 2 VOLTS/DIV	1 V
VOLTS/DIV Variable (both)	CAL detent
Magnification (both)	X1 (CAL knobs in)
AC-GND-DC (both)	DC

Horizontal

POSITION (COARSE and FINE)	Midrange
MAG	X1
SEC/DIV	0.2 μs
SEC/DIV Variable	CAL detent

Trigger

SLOPE	Positive (up)
LEVEL	Midrange
MODE	P-P AUTO
HOLDOFF	MIN
SOURCE	VERT MODE
COUPLING	DC

Display

STORE/NON-STORE	NON-STORE (button out)

PROCEDURE STEPS

1. Check Trigger Sensitivity

a. Connect the leveled sine-wave generator output via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input connector.

b. Set the generator to produce a 3.5-division display at an output frequency of 5 MHz.

c. Set Channel 1 VOLTS/DIV switch to 1 V.

d. CHECK—stable display can be obtained by adjusting the Trigger LEVEL control for each switch combination given in Table 4-4 in both positive and negative slope. Ensure that the TRIG'D light comes on when triggered.

e. Move the test-signal cable from the CH 1 OR X input connector to the CH 2 OR Y input connector. Set the Vertical MODE switch to CH 2.

f. Repeat part d.

g. Set the generator to produce a 1 division display at an output frequency of 50 MHz.

h. Repeat part d.

i. Move the test-signal cable from the CH 2 OR Y input connector to the CH 1 OR X input connector. Set the Vertical MODE switch to CH 1.

j. Repeat part d.

k. Disconnect the test equipment from the instrument.

l. Set:

CH 1 VOLTS/DIV	10 mV
SEC/DIV	0.2 μs
Trigger MODE	P-P AUTO
Trigger SOURCE	EXT, EXT

Table 4-4
Switch Combinations for Triggering Checks

Trigger Mode	Trigger SLOPE
NORM	POSITIVE (_/‾)
NORM	NEGATIVE (‾_)
P-P AUTO	POSITIVE (_/‾)
P-P AUTO	NEGATIVE (‾_)

m. Connect the leveled sine-wave generator output via a 50-Ω BNC coaxial cable, a 50-Ω BNC termination and a dual-input coupler to the CH 1 OR X input connector and EXT INPUT OR Z input connectors.

n. Set the generator to produce a four-division (40 mV) horizontal display at an output frequency of 5 MHz.

o. Repeat part d.

p. Set the CH 1 VOLTS/DIV to 50 mV. Set the generator to produce a 5 division (150 mV) display at an output frequency of 50 MHz.

q. Repeat part d.

r. Disconnect the test equipment from the instrument.

2. Check LF P-P AUTO Trigger

a. Set:

CH 1 VOLTS/DIV	0.1 V
SEC/DIV	2 ms
Trigger MODE	P-P AUTO
Trigger SOURCE	CH 1
Trigger SLOPE	Positive (_/‾)

b. Connect the low-frequency sine wave generator output via a 50 Ω BNC cable and a 600 Ω BNC termination to the CH 1 OR X input connector.

c. Set the low-frequency generator output to produce a 20 Hz one-division display.

d. CHECK—for stable triggering in both positive and negative slopes. Ensure that the TRIG'D light comes on when triggered.

e. Disconnect the test equipment from the instrument.

3. Check LF Reject

a. Set:

SEC/DIV	10 μs
Horizontal MAG	X1
Vertical MODE	CH 2, NORM
CH 2 VOLTS/DIV	0.1 V, AC COUPLED
Trigger MODE	P-P AUTO
Trigger SOURCE	CH 2
Trigger SLOPE	Positive
Trigger COUPLING	LF REJ

b. Set calibration generator for 10 kHz square wave.

c. Connect generator output to CH 2 input connector.

d. Adjust the generator output to display a 3 division waveform.

e. Set Trigger MODE to NORM.

f. Adjust Trigger LEVEL control fully clockwise.

g. Rotate Trigger LEVEL control counterclockwise until waveform just triggers.

h. Set CH 2 VOLTS/DIV to 50 mV and Horizontal MODE to X10.

i. Position vertical transition to the right side of screen.

j. CHECK—that when switching the Trigger SLOPE switch from positive to negative, the vertical transition is advanced horizontally by 3.2 to 5.2 divisions.

4. Check HF Reject

a. Set Trigger SLOPE to positive, Trigger COUPLING to DC.

b. Adjust Trigger LEVEL for stable trigger.

c. Adjust Horizontal POSITION controls to set vertical transition after 10 divisions of sweep, to the center vertical graticule line.

d. Set Trigger COUPLING to HF REJ.

e. Adjust Trigger LEVEL control so that when switching the Trigger SLOPE switch between positive and negative, the vertical transition does not move horizontally by more than 0.2 division.

f. CHECK—that when switching the Trigger COUPLING switch between DC and HF REJ, the vertical transition is advanced horizontally by 3.1 to 5.1 divisions.

g. Disconnect the test equipment from the instrument.

5. Check External Trigger Range

a. Set:

Vertical MODE	CH 1
CH 1 VOLTS/DIV	0.5 V
SEC/DIV	20 μs
Trigger COUPLING	AC
Trigger SLOPE	Positive (_/‾)

b. Connect the leveled sine-wave generator output via a 50 Ω BNC coaxial cable, a 50 Ω BNC termination, and a dual-input coupler to both the CH 1 OR X and EXT INPUT connectors.

c. Set the leveled sine-wave generator to produce a 50 kHz, five-division display.

d. Position the waveform equally about the center horizontal graticule line.

e. Set:

Trigger MODE	NORM
Trigger SOURCE	EXT, EXT

f. CHECK—that the display is not triggered at either extreme of rotation of the Trigger LEVEL control.

g. Set the Trigger COUPLING switch to DC.

h. CHECK—that the display is not triggered at either extreme of rotation of the Trigger LEVEL control.

i. Set the trigger SOURCE switch to EXT/10.

j. CHECK—that the display can be triggered about the midrange of the Trigger LEVEL control.

k. Set the Trigger SLOPE switch to Negative (‾_) and repeat part j.

l. Disconnect the test equipment from the instrument.

6. Check Trigger Readout

a. Set:

CH 1 VOLTS/DIV	0.1 V, DC COUPLED
Horizontal MAG	X1
SEC/DIV	20 μs
Trigger MODE	P-P AUTO
Trigger SOURCE	CH 1
Trigger COUPLING	DC
READOUT	"ON"

b. Connect the leveled sine-wave generator output via a 50 Ω BNC coaxial cable and a 50 Ω BNC termination to the CH 1 OR X input connector.

c. Set the generator to produce an 8 division vertical display at an output frequency of 50 kHz.

d. Adjust the CH 1 POSITION control to center the trace about the center horizontal graticule line. Set Trigger MODE to NORM.

e. Adjust the Trigger LEVEL control so that the trace starts equally about the center horizontal graticule line when switching between positive and negative slope.

f. Set the Trigger SLOPE switch to positive (_/‾).

g. Adjust the CH 1 POSITION control so that the start of the trace is aligned with the center horizontal graticule line.

h. CHECK—that the trigger readout is 0.00V ± 0.03V.

i. Adjust the Trigger LEVEL control so that the trace starts 1 division above the center horizontal graticule line.

j. CHECK—that the trigger readout is +0.10V ±0.03V.

k. CHECK—that when the trace starts 2 division above the center horizontal graticule line that the readout is +0.20V ±0.03V, and for 3 divisions it is +0.30V, ±0.03V.

l. CHECK—that when the trace starts 1 division below the center horizontal graticule line that the readout is -0.10V ±0.03V, for 2 divisions it is -0.20V ±0.03V and for 3 divisions it is -0.30V ±0.03V.

m. Adjust the CH 1 POSITION control to center the trace about the center horizontal graticule line.

n. Adjust the Trigger LEVEL control so that the trace starts equally about the center horizontal graticule line when switching between positive and negative slopes.

o. Set the TRIGGER SLOPE switch to Negative (⌐_).

p. Adjust the CH 1 POSITION control so that the start of the trace is aligned with the center horizontal graticule line.

q. Repeat steps h through l.

r. Disconnect the test equipment from the instrument.

7. Check Single Sweep Operation

a. Set:

CH 1 VOLTS/DIV	10 mV
SEC/DIV	0.5 ms
Trigger SOURCE	CH 1
Trigger COUPLING	AC
Trigger SLOPE	Positive (_⌐)

b. Connect 50 mV standard amplitude signal from the calibration generator via a 50 Ω BNC coaxial cable to the CH 1 OR X input connector.

c. Adjust the Trigger LEVEL control to obtain a stable display.

d. Set:

CH 1 AC-GND-DC	GND
Trigger MODE	SGL SWP

e. Press the SGL SWP RESET button. The READY light should light up and remain on.

f. Set the Channel 1 AC-GND-DC switch to DC.

NOTE

The INTENSITY control may require adjustment to observe the single-sweep trace.

g. CHECK—READY light goes out and a single sweep occurs.

h. Press in the SGL SWP button several times.

i. CHECK—single-sweep trace occurs, and the READY light comes on briefly every time the SGL SWP RESET button is pressed.

j. Disconnect the test equipment from the instrument.

EXTERNAL Z-AXIS AND PROBE ADJUST

Equipment Required (See Table 4-1):

Leveled Sine-Wave Generator (Item 2)	50-Ω BNC Termination (Item11)
Two 50-Ω BNC Coaxial Cables (Item 9)	10X Probe (provided with instrument)
Dual-Input Coupler (Item 10)	Low-Reactance Alignment Tool (Item 16)

INITIAL CONTROL SETTINGS

Vertical

CH 1 POSITION	Midrange
MODE	CH 1, NORM
CH 1 VOLTS/DIV	1 V
CH 1 VOLTS/DIV Variable	CAL detent
Magnification	X1 (CH 1 CAL knob in)
CH 1 AC-GND-DC	DC

Horizontal

POSITION (COARSE and FINE)	Midrange
MAG	X1
SEC/DIV	20 μs
SEC/DIV Variable	CAL detent

Trigger

SLOPE	Positive (⌐)
LEVEL	Midrange
MODE	P-P AUTO
HOLDOFF	MIN
SOURCE	EXT, EXT=Z
COUPLING	DC

Storage

STORE/NON-STORE	NON-STORE (button out)

PROCEDURE STEPS

1. Check External Z-Axis Operation

a. Connect the leveled sine-wave generator output via a 50-Ω BNC coaxial cable, a 50-Ω termination, and a dual-input coupler to the CH 1 OR X input connector and the EXT INPUT OR Z connector.

b. Set the generator to produce a 5 V, 50 kHz signal.

NOTE

The INTENSITY level may need adjustment to view the intensity modulation on the displayed waveform.

c. CHECK—for noticeable intensity modulation. The positive part of the sine wave should be of lower intensity than the negative part.

d. Disconnect the test equipment from the instrument.

2. Check Probe Adjust Operation

a. Set:

CH 1 VOLTS/DIV	10 mV
SEC/DIV	0.5 ms
Trigger SOURCE	CH 1

b. Connect the 10X Probe to the CH 1 OR X input connector and clip the probe tip to the PROBE ADJUST connector on the instrument front panel. If necessary, adjust the probe compensation for a flat-topped square-wave display.

c. CHECK—display amplitude is 4.75 to 5.25 divisions.

d. Disconnect the probe from the instrument.

STORAGE

Equipment Required (See Table 4-1):

Calibration Generator (Item 1)	Pulse Generator (Item 5)
Leveled Sine-Wave Generator (Item 2)	50-Ω BNC Coaxial Cable (Item 9)
Time Mark Generator (Item 3)	Dual-Input Coupler (Item 10)
Low-Frequency Sine-Wave Generator (Item 4)	50-Ω BNC Termination (Item11)

INITIAL CONTROL SETTINGS

Vertical

POSITION (both)	Midrange
MODE	CH 1, NORM
VOLTS/DIV (both)	5 mV
VOLTS/DIV Variable (both)	CAL detent
Magnification	X1 (CAL knobs in)
AC-GND-DC	DC

Horizontal

POSITION (COARSE and FINE)	Midrange
SEC/DIV	0.5 ms
SEC/DIV Variable	CAL detent
MAG	X1

Trigger

SLOPE	Positive (_/‾)
LEVEL	Midrange
MODE	P-P AUTO
HOLDOFF	MIN
SOURCE	VERT MODE
COUPLING	DC

Storage

STORE/NON-STORE	NON-STORE
PRE-TRIG 25%/75%	75%
ACQ SAVE/CONTINUE	CONTINUE
REFERENCE POSITION	Midrange

PROCEDURE STEPS

1. Check Storage VOLTS/DIV Accuracy

a. Connect a 20 mV standard-amplitude signal from the calibration generator via a 50-Ω BNC cable to the CH 1 OR X input connector.

b. CHECK—that there is a 4-division signal displayed on the screen.

c. Set:

STORE/NON-STORE	STORE
ACQ SAVE/CONTINUE	SAVE

d. CHECK—that the displayed signal is within the limits given in Table 4-5 for each CH 1 VOLTS/DIV switch setting and corresponding standard-amplitude signal. At each level, select CONTINUE then SAVE to acquire and hold the next test waveform.

e. Set the calibration generator to output 20 mV.

f. Move the cable from the CH 1 OR X input connector to the CH 2 OR Y input connector.

g. Set:

Vertical MODE	CH 2
STORE/NON-STORE	NON-STORE
ACQ SAVE/CONTINUE	CONTINUE

h. Repeats parts b through d for CH 2.

i. Set:

STORE/NON-STORE	NON-STORE
ACQ SAVE/CONTINUE	CONTINUE

Table 4-5
Storage Deflection Accuracy Limits

VOLTS/DIV Switch Setting	STANDARD Amplitude Signal	ACCURACY Limits (Divisions)
5 mV	20 mV	3.88 to 4.12
10 mV	50 mV	4.85 to 5.15
20 mV	0.1 V	4.85 to 5.15
50 mV	0.2 V	3.88 to 4.12
0.1 V	0.5 V	4.85 to 5.15
0.2 V	1 V	4.85 to 5.15
0.5 V	2 V	3.88 to 4.12
1 V	5 V	4.85 to 5.15
2 V	10 V	4.85 to 5.15
5 V	20 V	3.88 to 4.12

2. Check Store Add Mode

a. Set:

SEC/DIV	0.2 ms
VOLTS/DIV (both)	20 mV
Vertical MODE	BOTH, ADD, NORM
STORE/NON-STORE	NON-STORE

b. Set the calibration generator to output 50 mV and connect it via a dual-input coupler to both CH 1 (X) and CH 2 (Y) inputs.

c. Position the display around the center horizontal graticule line.

d. CHECK—that the displayed signal is between 4.85 and 5.15 divisions in height.

e. Set:

STORE/NON-STORE	STORE

f. CHECK—that the displayed signal is between 4.85 and 5.15 divisions in height.

g. Disconnect the test equipment from the instrument.

3. Check CH 1 Storage Balance

a. Set:

SEC/DIV	0.2 ms
Vertical MODE	CH 1, NORM
VOLTS/DIV (CH 1)	5 mV
AC-GND-DC (CH 1)	GND
Trigger SOURCE	EXT
STORE/NON-STORE	NON-STORE

b. Position the trace to the center horizontal graticule line using the CH 1 POSITION control.

c. Set STORE/NON-STORE to STORE.

d. CHECK—that the trace is positioned within 0.5 of a division of the center horizontal graticule line.

4. Check CH 2 Storage Balance

a. Set:

Vertical MODE	CH 2, NORM
VOLTS/DIV (CH 2)	5 mV
AC-GND-DC (CH 2)	GND
STORE/NON-STORE	NON-STORE

b. Using the CH 2 POSITION control, position the trace to the center horizontal graticule.

c. Set STORE/NON-STORE to STORE.

d. CHECK—that the trace is positioned within 0.5 of a division of the center horizontal graticule.

5. Check Add Storage Balance

a. Set:

Vertical MODE	BOTH, ADD
STORE/NON-STORE	NON-STORE

b. Position the trace to the center horizontal graticule line.

c. Set:

STORE/NON-STORE	STORE

d. CHECK—that the trace is positioned within 0.5 of a division of the center horizontal graticule line.

6. Check Vertical Bandwidth

a. Set:

Vertical MODE	CH 1, NORM, ALT
SEC/DIV	20 μs
Trigger SOURCE	VERT
Trigger COUPLING	AC
AC-GND-DC (both)	DC
STORE/NON-STORE	NON-STORE

b. Connect a 50 kHz signal from the leveled sine-wave generator via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input.

c. CHECK—that the trace has a height of 6 divisions.

d. Increase the signal frequency until a 4.2 division display is obtained.

e. CHECK—that the frequency is greater than 10 MHz.

f. Repeat parts c through e for all VOLTS/DIV settings.

g. Set Vertical MODE to CH 2.

h. Reduce the signal generator output level to minimum and move the test signal to the CH 2 input.

i. Repeat parts c through e for CH 2 using the CH 2 controls

7. Check Store Mode Channel Isolation

a. Set:

VOLTS/DIV (CH 2)	0.5 V
VOLTS/DIV (CH 1)	1 V
AC-GND-DC (CH 2)	GND

b. Connect a 50 MHz, 5 V peak to peak signal from a leveled sine-wave generator via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input.

c. Increase the generator frequency to 10 MHz.

d. Set:

Vertical MODE	CH 2
CH 1 VOLTS/DIV	0.5 V

e. CHECK—that the displayed signal is less than 0.1 division in height.

f. Move the test signal to the CH 2 input.

g. Set:

Vertical MODE	CH 2
AC-GND-DC (CH 1)	GND
AC-GND-DC (CH 2)	DC

h. CHECK—that the displayed signal amplitude is less than 0.1 divisions.

i. Disconnect the test equipment from the instrument.

8. Check Common Mode Rejection Ratio

a. Set:

VOLTS/DIV (both)	5 mV
AC-GND-DC (CH 2)	DC

b. Connect a 50 kHz signal from the leveled sine-wave generator via a dual-input coupler to both the CH 1 (X) and CH 2 (Y) inputs.

c. Set the generator to give a 6 division display.

d. Set Vertical MODE to BOTH, CH 2 INVERT, ADD.

e. Increase the signal frequency to 10 MHz.

f. CHECK—that the residual display is less than 0.6 division.

g. Disconnect the test equipment from the instrument.

9. Check Display and Save Ref

a. Set:

Vertical MODE	CH 1
AC-GND-DC (CH 1)	GND
Trigger SOURCE	CH 1
Trigger COUPLING	DC
PRE-TRIG	25%

b. Adjust the CH 1 POSITION control so that the trace is on the second from bottom horizontal graticule line.

c. Press SAVE REF.

d. CHECK—that the SAVE REF trace appears and can be positioned more than 3.5 divisions above the reference trace using the Reference Position control.

e. Press the Display ON/OFF button.

f. CHECK—that the SAVE REF trace disappears.

g. Press the Display ON/OFF button.

h. CHECK—that the SAVE REF trace appears and that the Trigger Point (bright dot) is positioned at the same place on both traces.

i. Set:

PRE-TRIG	75%

j. CHECK—that the CH 1 display and Trigger Point change but that the REF display remains the same.

10. Check Save/Continue

a. Position the trace on the center horizontal graticule using the CH 1 POSITION control.

b. Press SAVE/CONTINUE.

c. CHECK—that the trace cannot be moved vertically using the Vertical POSITION control.

d. Press SAVE/CONTINUE.

e. CHECK—that the trace can be moved using the Vertical POSITION control.

11. Check Trigger Point

a. Set:

SEC/DIV	50 ms
PRE-TRIG	25%

b. CHECK—that the Trigger Point appears towards the beginning of the trace.

c. Set PRE-TRIG to 75%.

d. CHECK—that the Trigger Point appears towards the end of the trace.

e. Set SEC/DIV to 0.1 s.

f. CHECK—that the Trigger Point is not present.

g. Set Trigger MODE to Single Sweep.

h. CHECK—that the Trigger Point appears towards the end of the trace.

i. Set Trigger MODE to P-P AUTO and PRE-TRIG to 25%.

j. Set Trigger MODE to Single Sweep.

k. CHECK—that the Trigger Point appears towards the beginning of the trace.

12. Check Single Sweep

a. Set:

VOLTS/DIV (CH 1)	0.5 V
AC-GND-DC (CH 1)	DC
SEC/DIV	50 ms
Trigger MODE	NORM

b. Connect 0.1 s time markers from the time-mark generator via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input.

c. Adjust the Trigger LEVEL control for stable trigger.

d. Set SEC/DIV to 0.1 s and Trigger MODE to Single Sweep.

e. CHECK—that the display continually scrolls to the left.

f. Press the RESET button.

g. CHECK—that the Trigger indicator lights immediately and then goes out. When the Trigger indicator has gone out the display should stop scrolling.

h. Press the RESET button.

i. CHECK—that the display clears and both the Trigger indicator and the Trigger Point do not alight until the pre-trigger data is acquired.

j. Disconnect the test equipment from the instrument.

13. Check Roll Single Sweep Vert Chop-Alt Trigger

a. Set:

Vertical MODE	BOTH, NORM, ALT
VOLTS/DIV (both)	0.5 V
AC-GND-DC (both)	DC
SEC/DIV	50 ms
Trigger MODE	NORM
Trigger SOURCE	VERT

b. Connect 0.1 s time markers from the time-mark generator via a dual-input coupler to both the CH 1 (X) and the CH 2 (Y) inputs.

c. Adjust the Trigger LEVEL control for stable trigger.

d. Position the CH 1 trace to the top of the display and CH 2 to the bottom.

e. Set SEC/DIV to 0.1 s and Trigger MODE to Single Sweep.

f. CHECK—that the display continually scrolls to the left.

g. Press RESET.

h. CHECK—that both channels trigger and remain on the screen.

i. CHECK—that every subsequent press of the RESET button updates CH 1 OR CH 2 data alternately.

j. Press the RESET button until CH 2 is displayed on the screen.

k. Disconnect CH 1 input.

l. Press the RESET button.

m. CHECK—that the display continually scrolls to the left until CH 1 input is reconnected.

n. Disconnect CH 2 input.

o. Press the RESET button.

p. CHECK—that the display continually scrolls to the left until CH 2 input is reconnected.

q. Set Vertical MODE to CHOP.

r. Press the RESET button.

s. CHECK—that both channels are displayed and triggered.

t. Disconnect the test equipment from the instrument.

14. Check External Clock Record Mode

a. Set:

Vertical MODE	CH 1, NORM, ALT
SEC/DIV	EXT CLK
Trigger MODE	P-P AUTO
Trigger SOURCE	CH 1

b. Connect a 0–5 V 10 MHz square wave with an equal mark-to-space ratio from the pulse generator via a 50-Ω BNC coaxial cable to the EXT INPUT OR Z connector.

c. Connect 20 μs time markers from the time-mark generator via a 50-Ω BNC coaxial cable and a 50-Ω BNC terminator to the CH 1 OR X input.

d. Set SAVE/CONTINUE to SAVE.

e. CHECK—that the displayed signal has 2 markers per division.

f. Disconnect the test equipment from the instrument.

15. Check External Clock Roll Mode

a. Set SAVE/CONTINUE to CONTINUE.

b. Turn the SEC/DIV Variable control fully counterclockwise.

c. Connect a 0–5 V 4 kHz square wave with equal mark-to-space ratio from the pulse generator via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the EXT INPUT OR Z connector.

d. Connect 0.1 s time makers from the time-mark generator via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input.

e. Set SAVE/CONTINUE to SAVE.

f. CHECK—that the displayed signal has 1 marker per division.

g. Return the SEC/DIV Variable control to its detent position.

h. Disconnect the test equipment from the instrument.

CURSORS AND READOUT

Equipment Required (See Table 4-1):

Time-Mark Generator (Item 3)
50-Ω Coaxial Cable (Item 9)
50-Ω BNC Termination (Item 11)

INITIAL CONTROL SETTINGS

Vertical

POSITION	Midrange
MODE	CH 2, NORM, ADD
VOLTS/DIV (both)	10 mV
VOLTS/DIV Variable (both)	CAL detent
Magnification	X1 (CAL knobs in)
AC-GND-DC	GND

Horizontal

POSITION (COARSE and FINE)	Midrange
SEC/DIV	0.05 μs
SEC/DIV Variable	CAL detent
MAG	X1

Trigger

SLOPE	Positive (up)
LEVEL	Midrange
MODE	SGL SWP
HOLDOFF	MIN
SOURCE	EXT
COUPLING	AC

Storage

STORE/NON-STORE	NON-STORE
PRE-TRIG 25%/75%	75%
ACQ SAVE/CONTINUE	CONTINUE
REFERENCE POSITION	Midrange

Cursors and Readout

READOUT/STORE INTENSITY	READOUT OFF

PROCEDURE STEPS

1. **Check Operation of Readout**

a. Hold in the ΔV1/ΔV2 and ΔT/1/ΔT push buttons until the Tektronix logo appears on the crt screen.

b. Press the Cursor Position control four times,and check that a diagnostic table appears on the screen.

c. Hold the Cursor Position control in for approximately two seconds until the next menu appears on the crt screen.This menu indicates the last switch/control changed.

d. Set Vertical MODE to BOTH and check that the screen displays VMODE BOTH ADD.

e. Set Vertical MODE to ALT and check that the screen displays VMODE BOTH ALT.

f. Set Vertical MODE to CHOP and check that the screen displays VMODE BOTH CHOP.

g. Set Vertical MODE to CH 1 and check that the screen displays VMODE CH1.

h. Set Vertical MODE to CH 2 and check that the screen displays VMODE CH2.

i. Set Vertical MODE to INV and check that the screen displays VMODE INVERT.

j. Set Vertical MODE to NORM and check that the screen displays VMODE NORM.

k. Set AC-GND-DC (CH 1) to AC and check that the screen displays CH1 CPLNG AC.

l. Set AC-GND-DC (CH 1) to DC and check that the screen displays CH1 CPLNG DC.

m. Set AC-GND-DC (CH 2) to AC and check that the screen displays CH2 CPLNG AC.

n. Set AC-GND-DC (CH 2) to DC and check that the screen displays CH2 CPLNG DC.

o. Set CH 1 Variable to X10 and check that the screen displays CH1 X10.

p. Set CH 1 Variable to X1 and check that the screen displays CH1 X1.

q. Set CH 1 Variable to UNCAL and check that the screen displays CH1 UNCAL.

r. Set CH 1 Variable to CAL and check that the screen displays CH1 CAL.

s. Set CH 2 Variable to X10 and check that the screen displays CH2 X10.

t. Set CH 2 Variable to X1 and check that the screen displays CH2 X1.

u. Set CH 2 Variable to UNCAL and check that the screen displays CH2 UNCAL.

v. Set CH 2 Variable to CAL and check that the screen displays CH2 CAL.

w. Set VOLTS/DIV (CH 1) to 5 mV and check that the screen displays CH1 VOLTS 5 mV.

x. Switch the CH 1 VOLTS/DIV control through its various settings, checking that the crt screen displays the values shown in Table 4-6.

Table 4-6

VOLTS/DIV Switch Settings/Screen Displays

Switch Setting		Screen Display
10 mV	(CH 1/2)	CH 1/2 VOLTS 10 mV
20 mV	(CH 1/2)	CH 1/2 VOLTS 20 mV
50 mV	(CH 1/2)	CH 1/2 VOLTS 50 mV
0.1 V	(CH 1/2)	CH 1/2 VOLTS 0.1 V
0.2 V	(CH 1/2)	CH 1/2 VOLTS 0.2 V
0.5 V	(CH 1/2)	CH 1/2 VOLTS 0.5 V
1 V	(CH 1/2)	CH 1/2 VOLTS 1 V
2 V	(CH 1/2)	CH 1/2 VOLTS 2 V
5 V	(CH 1/2)	CH 1/2 VOLTS 5 V

y. Repeat items w and x for the CH 2 VOLTS/DIV switch.

z. Set the Horizontal MAG switch to X10 and check that the screen displays SEC MAG X10.

aa. Set the Horizontal MAG switch to X50 and check that the screen displays SEC MAG X50.

bb. Set the Horizontal MAG switch to X1 and check that the screen displays SEC MAG X1.

cc. Set the SEC/DIV switch to X-Y and check that the screen displays SEC/DIV X-Y.

dd. Switch the SEC/DIV switch through its various settings and check that the screen displays agree with those given in Table 4-7.

Table 4-7

SEC/DIV Switch Settings/Screen Displays

SEC/DIV Switch Setting	Screen Display
0.5 s	SEC/DIV 0.5 s
0.2 s	SEC/DIV 0.2 s
0.1 s	SEC/DIV 0.1 s
50 ms	SEC/DIV 50 ms
20 ms	SEC/DIV 20 ms
10 ms	SEC/DIV 10 ms
5 ms	SEC/DIV 5 ms
2 ms	SEC/DIV 2 ms
1 ms	SEC/DIV 1 ms
0.5 ms	SEC/DIV 0.5 ms
0.2 ms	SEC/DIV 0.2 ms
0.1 ms	SEC/DIV 0.1 ms
50 μs	SEC/DIV 50 μs
20 μs	SEC/DIV 20 μs
10 μs	SEC/DIV 10 μs
5 μs	SEC/DIV 5 μs
2 μs	SEC/DIV 2 μs
1 μs	SEC/DIV 1 μs
0.5 μs	SEC/DIV 0.5 μs
0.2 μs	SEC/DIV 0.2 μs
0.1 μs	SEC/DIV 0.1 μs
0.05 μs	SEC/DIV 0.05 μs

ee. Set Trigger MODE,SOURCE and COUPLING to the settings given in Table 4-8 and check that the screen displays agree with those given.

ff. Press the Cursor ON/OFF push button several times and check that the screen display switches between CURSOR ON and CURSOR OFF.

gg. Press the TRACK/INDEP push button several times and check that the screen display switches between CURSOR TRACK and CURSOR INDEP.

hh. Press the STORE/NON-STORE push button several times and check that the screen display switches between STORE and NON-STORE.

ii. Press the SAVE/CONTINUE push button several times and check that the screen display switches between ACQ SAVE and ACQ CONTINUE.

jj. Press the Cursor Position control followed by the ΔV1/ΔV2 push button to end the check.

kk. Press the STORE/NON-STORE push button several times and check that the screen display switches between STORE and NON-STORE.

ll. Press the SAVE/CONTINUE push button several times and check that the screen display switches between ACQ SAVE and ACQ CONTINUE.

mm. Press the Cursor Position control followed by the ΔV1/ΔV2 push button to end the check.

Table 4-8

Trigger MODE, SOURCE and COUPLING Switch Settings/Screen Displays

Switch	Setting	Screen Display	
MODE	P-P AUTO	TRIG MODE	P-P AUTO
MODE	NORM	TRIG MODE	NORM/SGL
MODE	TV FIELD	TRIG MODE	TV-FIELD
MODE	SGL SWP	TRIG MODE	NORM/SGL
SOURCE	CH 1	TRIG SRC	CH 1
SOURCE	VERT	TRIG SRC	VERT
SOURCE	CH 2	TRIG SRC	CH 2
SOURCE	EXT	TRIG SRC	EXT
COUPLING	DC	TRIG CPLNG	DC
COUPLING	HF REJ	TRIG CPLNG	HF-REJ
COUPLING	LF REJ	TRIG CPLNG	LF-REJ
COUPLING	AC	TRIG CPLNG	AC

2. Check Probe Encoding

a. Set:

VOLTS/DIV (both)	0.1 V
Vertical MODE	CH 1

b. Read the 0.1 V on the Channel 1 VOLTS/DIV portion of the crt readout.

c. Connect the standard accessory 10X probe to the CH 1 OR X connector.

d. CHECK—the Channel 1 VOLTS/DIV portion of the crt readout changes from 0.1V to 1V.

e. Set Vertical MODE to CH 2.

f. Move the X10 probe from the CH 1 OR X input connector or the CH 2 OR Y input connector.

g. CHECK—the Channel 2 VOLTS/DIV portion of the crt readout changes from 0.1V to 1V.

h. Disconnect the X10 probe from the instrument.

3. Check Cursor Accuracy

a. Set:

Vertical MODE	CH 1, NORM
VOLTS/DIV (both)	5 mV
AC-GND-DC (both)	DC
SEC/DIV	1 ms
Trigger MODE	P-P AUTO
Trigger SOURCE	VERT MODE
Trigger COUPLING	DC
Cursors ON/OFF	ON
STORE/NON-STORE	NON-STORE

b. Press the ΔV1/ΔV2 push button.

c. Position the cursors, using Cursor Position control, exactly two divisions above and below the center horizontal graticule line.

d. CHECK—that the ΔV1 readout is between 19.80 mV and 20.0 mV.

e. Press the ΔT/1/ΔT push button.

f. Position the cursors, using the Cursor Position control, so that they are aligned with the second and tenth vertical graticule line.

g. CHECK—that the ΔT readout is between 7.92 ms and 8.08 ms.

h. Set to STORE.

i. Repeat part e, f, and g using a range of 7.960 ms to 8.040 ms.

NOTE

If the instrument fails this check the DAC CAL must be readjusted—see Section 5 Adjustment Procedure

j. Set:

VOLTS/DIV (CH 1)	0.5 V
STORE/NON-STORE	STORE

k. Connect 1 ms time markers from the time-mark generator via a 50 Ω BNC termination to the CH 1 OR X input connector.

l. Position the cursors, using the Cursor Position control, so that they are aligned with the tips of the second and tenth time markers.

m. CHECK— hat the ΔT readout is between 7.96 ms and 8.04 ms.

n. Disconnect the test equipment from the instrument.

SERIAL INTERFACE

Equipment Required (See Table 4-1):

IBM Compatible PC (Item 19)

GRABBER software (Item 17)

Interface Cable (Item 18)

1. Check Serial Interface Operation

a. Set:

CH 1 VOLTS/DIV	0.5V
CH 1 COUPLING	DC
CH 2 VOLTS/DIV	0.2 V
CH 2 COUPLING	DC
Vertical MODE	BOTH,NORM, ALT
Horizontal MAG	X1
SEC/DIV	0.2 ms
Trigger MODE	P-P AUTO
Trigger SOURCE	CH 1
Trigger COUPLING	DC
STORE/NON-STORE	STORE
CURSORS	ON
ΔT/1/Δ T	ΔT

SERIAL INTERFACE PARAMETERS switch set to:

1	2	3	4	5	6
ON	ON	OFF	OFF	ON	ON

b. Select drive A: of the computer and place the GRABBER floppy disk into this drive.

c. Connect the 9-way interface cable from COM1: of the computer to the serial interface socket on the RHS of the instrument.

d. Type "GRABBER COM1" followed by ENTER on the computer keyboard. A message will appear on the computer screen with the last line being "HIT ANY KEY TO CONTINUE".

e. Press any key on the computer keyboard.

f. Press the PLOT/PRINT button on the right hand side of the instrument.

g. Wait until the computer displays a representation of the instrument's crt display (this could take up to 5 minutes).

h. CHECK—that the waveforms displayed on the crt and the computer display are the same.

NOTE

If the traces or cursors are behind a graticule line they will not be visible on the computer display or on a plot.

1. Disconnect the test equipment from the instrument.

ADJUSTMENT PROCEDURE

INTRODUCTION

PURPOSE

The "Adjustment Procedure" is used to return the instrument to conformance with the Performance Requirement statements listed in Table 1-1. Adjustments contained in this procedure should only be performed after checks from the "Performance Check Procedure" (Section 4) have indicated a need for readjustment or after repairs have been made to the instrument.

STRUCTURE

This procedure is structured into subsections, each of which can be performed independently to permit adjustment of individual sections of the instrument. For example, if only the Vertical section fails to meet the Performance Requirements or has been repaired, it can be readjusted with little or no effect on other sections of the instrument.

The Power Supply section, however, affects all other sections of the instrument. Therefore, if repairs or readjustments have been made that change the absolute value of any of the supply voltages, the entire Adjustment Procedure should be performed.

At the beginning of each subsection is a list of all the front-panel control settings required to prepare the instrument for performing Step 1 in that subsection. Each succeeding step within a subsection should be performed in sequence and in its entirety to ensure that control settings will be correct for ensuing steps. All steps within a subsection should be completed.

TEST EQUIPMENT REQUIRED

Table 4-1 is a complete list of the test equipment required to accomplish both the "Performance Check Procedure" in Section 4 and the "Adjustment Procedure" in this section. To assure accurate measurements, it is important that test equipment used for making these checks meet or exceed the specifications described in Table 4-1. When considering use of equipment other than that recommended, utilize the "Minimum Specification" column to determine whether available test equipment will suffice.

Detailed operating instructions for test equipment are not given in this procedure. If more operating information is required, refer to the appropriate test equipment instruction manual.

LIMITS AND TOLERANCES

The limits and tolerances stated in this procedure are instrument specifications only if they are listed in the "Performance Requirements" column of Table 1-1. Tolerances given are applicable only to the instrument undergoing adjustment and do not include test equipment error. Adjustment of the instrument must be accomplished at an ambient temperature between +20°C and +30°C, and the instrument must have had a warm-up period of at least 20 minutes.

ADJUSTMENTS AFFECTED BY REPAIRS

Repairs to a circuit may affect one or more adjustment settings of the instrument. Table 5-1 identifies the adjustment(s) affected due to repairs or replacement of components on a circuit board. Refer to Table 5-1 if a partial procedure is performed or if a circuit requires readjustment due to repairs to a circuit. To use this table, first find, in the leftmost column, the circuit that was repaired. Then move to the right, across that row, until you come to a darkened square, move up the column and check the accuracy of the adjustment found at the heading of that column. Readjust if necessary.

PREPARATION FOR ADJUSTMENT

The instrument cabinet must be removed and the storage board placed in the vertical servicing position to perform the Adjustment Procedure. See the "Cabinet" and "Storage board remove and replace instructions" located in the "Maintenance" section of the manual.

All test equipment items listed in Table 4-1 in the performance check section are required to accomplish a complete Adjustment Procedure. At the beginning of each subsection there is an equipment-required list showing only the test equipment necessary for performing the steps in that subsection. In this list the item number following each piece of equipment corresponds to the item number listed in Table 4-1.

Before performing this procedure, do not preset any internal adjustments and do not change the -8.6 V power-supply adjustment. Altering this adjustment may necessitate a complete readjustment of the instrument, whereas only a partial adjustment might otherwise be required. Only change an internal adjustment setting if a Performance Characteristic cannot be met with the original setting.

Before performing any procedure in this section, set the POWER switch to ON and allow a 20-minute warm-up period.

The most accurate display adjustments are made with a stable, well-focused, low-intensity display. Unless otherwise noted, adjust the INTENSITY, FOCUS, and TRIGGER LEVEL controls as needed to view the display.

Table 5-1

Adjustments Affected by Repairs

ADJUSTMENTS OR REPLACEMENTS MADE	ADJUSTMENTS AFFECTED																							
	-8.6 V ADJ	GRID BIAS, ASTIG & GEOM	VAR BALANCE & INVERT BALANCE	CH 1 & CH 2 GAIN	X1/X10 BALANCE	ATTENUATOR COMP	HF COMP	1 ms TIMING	MAGNIFIER GAIN	MAGNIFIER REGISTRATION	10 µs, 5 µs TIMING	HIGH SPEED TIMING	X-Y GAIN & OFFSET	TRIGGER OFFSET CHANNEL BALANCE	TRIGGER HYSTERESIS	SLOPE BALANCE—P-P OFFSET	CH 1, CH 2 STORAGE BALANCE	CH 1, CH 2 STORAGE GAIN	ADD STORAGE BALANCE/GAIN	DAC CAL	READOUT JITTER	TRIGGER READOUT	X50 CURSOR ADJUSTMENT	1 ms STORAGE TIMING
-8.6 V ADJ	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■
GRID BIAS, ASTIG & GEOM		■						■	■		■	■							■					
VAR BALANCE & INVERT BALANCE			■		■																			
CH 1 & CH 2 GAIN				■																				
X1/X10 BALANCE																								
ATTENUATOR COMP						■	■																	
HF COMP							■	■																
1 ms TIMING								■	■		■	■												■
MAGNIFIER GAIN									■			■												
MAGNIFIER REGISTRATION										■														
10 µs, 5 µs TIMING											■	■												
HIGH SPEED TIMING												■												
X-Y GAIN & OFFSET													■											
TRIGGER OFFSET CHANNEL BALANCE													■	■										
TRIGGER HYSTERESIS															■	■	■							
SLOPE BALANCE—P-P OFFSET																■	■							
CH 1, CH 2 STORAGE BALANCE																	■							
CH 1, CH 2 STORAGE GAIN																		■						
ADD STORAGE BALANCE/GAIN																			■					
DAC CAL																				■				
READOUT JITTER							■														■			
TRIGGER READOUT																						■		
X50 CURSOR ADJUSTMENT																							■	
1 ms STORAGE TIMING																								■

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INDEX TO ADJUSTMENT PROCEDURE STEPS

POWER SUPPLY AND CRT DISPLAY

Equipment Required (See Table 4-1):

Leveled Sine-Wave Generator (Item 2)
Time-Mark Generator (Item 3)
Screwdriver (Item 6)
Digital Voltmeter (Item 8)
50-Ω BNC Coaxial Cable (Item 9)
50-Ω BNC Termination (Item 11)

INITIAL CONTROL SETTINGS

INTENSITY	Visible display

Vertical

POSITION (both)	Midrange
MODE	CH 1, NORM
VOLTS/DIV (both)	10 mV
VOLTS/DIV Variable (both)	CAL detent
Magnification (both)	X1 (CAL knobs in)
AC-GND-DC (both)	GND

Horizontal

POSITION (COARSE and FINE)	Midrange
SEC/DIV SWITCH	(X-Y fully ccw)
SEC/DIV Variable	CAL detent
MAG	X1

Trigger

SLOPE	POSITIVE (_/‾)
LEVEL	Midrange
MODE	P-P AUTO
HOLDOFF	MIN
SOURCE	EXT, EXT
COUPLING	AC

Storage

STORE/NON-STORE	NON-STORE

PROCEDURE STEPS

1. Check/Adjust Power Supply DC Levels (R933)

NOTE

Review the information at the beginning of the Adjustment Procedure before starting this step.

a. Connect the digital voltmeter low lead to chassis ground and connect the volts lead to the -8.6V supply (W989).

b. CHECK—voltmeter reading is -8.56 to -8.64V. If the reading is within these limits, skip to part d.

c. ADJUST—the -8.6V Adj. potentiometer (R933) for a voltmeter reading of -8.60V.

d. CHECK—voltage levels of the remaining power supplies listed in Table 5-2 are within the specified limits.

Table 5-2
Power Supply Limits

Power Supply	Test Point	Reading (Volts)
-8.6 V	W989	-8.56 V to -8.64 V
-5.2 V	W993	-5.04 V to -5.35 V
+5.1 V	W991	+4.95 V to +5.25 V
+8.7 V	W987	+8.53 V to +8.87 V
+38 V	W972	+36.8 V to +39.1 V
+99 V	W984	+96.0 V to +101.9 V

e. Disconnect the test equipment from the instrument.

2. Adjust CRT Grid Bias (R851)

a. Adjust the front-panel FOCUS control to produce a well-defined dot.

b. Rotate the INTENSITY control fully counterclockwise.

c. ADJUST—Grid Bias (R851) for a visible dot. Then back off the Grid Bias potentiometer until the dot just disappears.

3. Adjust Astigmatism (R874)

a. Set:

Vertical MODE	CH 1
Channel 1 AC-GND-DC	DC
SEC/DIV	5 μs
Trigger SOURCE	CH 1

b. Connect the leveled sine-wave generator output via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input connector.

c. Set the generator to produce a 50 kHz, four-division display.

d. ADJUST—Astig (R874) and the front-panel FOCUS control for the best defined waveform.

e. Disconnect the test equipment from the instrument.

4. Adjust Trace Alignment

a. Position the trace to the center horizontal graticule line.

b. ADJUST—Front-panel TRACE ROTATION control for optimum alignment of the trace with the center horizontal graticule line.

5. Adjust Geometry (R870)

a. Set:

CH 1 VOLTS/DIV	50 mV
SEC/DIV	0.1 ms

b. Connect 50 μs time markers from the time-mark generator via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input connector.

c. Position the baseline part of the display below the bottom horizontal graticule line using the CH 1 POSITION control.

d. Adjust the SEC/DIV Variable control for five markers per division.

e. ADJUST—Geom (R870) for minimum curvature of the time markers at the left and right edges of the graticule.

f. Set Channel 1 AC-GND-DC switch to GND.

g. ADJUST—Geom (R870) for minimum curvature of the baseline trace when positioned at the top and bottom horizontal graticule lines using the CH 1 POSITION control.

h. Set the Channel 1 AC-GND-DC switch to DC.

i. Repeat parts e through h for optimum compromise between the vertical and horizontal displays.

j. Disconnect the test equipment from the instrument.

VERTICAL

Equipment Required (See Table 4-1):

Calibration Generator (Item 1)	50-Ω BNC Termination (Item11)
Leveled Sine-Wave Generator (Item 2)	10X Attenuator (Item 13)
Screwdriver (Item 6)	BNC Male-to-Miniature-Probe Tip (Item 14)
50-Ω BNC Coaxial Cable (Item 9)	Low-Reactance Alignment Tool (Item 16)
Dual-Input Coupler (Item 10)	10X Probe (Provided with instrument)

INITIAL CONTROL SETTINGS

Vertical

POSITION (both)	Midrange
MODE	CH 1, NORM
VOLTS/DIV (both)	5 mV
VOLTS/DIV Variable (both)	CAL detent
Magnification	X1 (CAL knobs in)
AC-GND-DC (both)	GND

Horizontal

POSITION (COARSE and FINE)	Midrange
SEC/DIV	0.5 ms
SEC/DIV Variable	CAL detent
MAG	X1

Trigger

SLOPE	POSITIVE (_⌐)
LEVEL	Midrange
MODE	P-P AUTO
HOLDOFF	MIN
SOURCE	EXT, EXT
COUPLING	AC

Storage

STORE/NON-STORE	NON-STORE

PROCEDURE STEPS

1. Adjust Channel 1 Variable Balance (R33)

a. Rotate the CH 1 VOLTS/DIV Variable control fully counterclockwise.

b. Position the trace on the center horizontal graticule line using the CH 1 POSITION control.

c. Rotate the CH 1 VOLTS/DIV Variable control clockwise to the CAL detent.

d. ADJUST—Var Bal (R33) to set the trace to the center horizontal graticule line.

e. Repeat parts a through d until there is no trace shift between the fully clockwise and the fully counterclockwise positions of the CH 1 VOLTS/DIV Variable control.

f. Return the CH 1 VOLTS/DIV Variable control to the CAL detent.

2. Adjust Channel 2 Variable Balance (R84)

a. Set Vertical MODE to CH 2.

b. Rotate the CH 2 VOLTS/DIV Variable control fully counterclockwise.

c. Position the trace on the center horizontal graticule line using the CH 2 POSITION control.

d. Rotate the CH 2 VOLTS/DIV Variable control clockwise to the CAL detent.

e. ADJUST—Var Bal (R84), located on Front Panel Board, to set the trace to the center horizontal graticule line.

f. Repeat parts b through e until there is no trace shift between the fully clockwise and the fully counterclockwise positions of the CH 2 VOLTS/DIV Variable control.

g. Return the CH 2 VOLTS/DIV Variable control to the CAL detent.

3. Adjust Channel 2 Invert Balance (R83)

a. Position the trace on the center horizontal graticule line using the CH 2 POSITION control.

b. Set Vertical MODE switch to CH 2, INVERT.

c. ADJUST—Invert Bal (R83) to set the trace to the center horizontal graticule line.

d. Set Vertical MODE switch to NORM.

e. Repeat parts a through d until there is no trace shift when switching from NORM to CH 2 INVERT.

4. Adjust Vertical Gain (R145, R195, R112, and R162)

a. Set:

Vertical MODE	CH 1, NORM
AC-GND-DC (both)	DC
Trigger SOURCE	VERT MODE
Trigger COUPLING	DC

b. Connect a 20 mV standard-amplitude signal from the calibration generator via a 50-Ω BNC coaxial cable to the CH 1 OR X input connector.

c. Center the display within the graticule using the CH 1 POSITION control.

d. ADJUST—Ch 1 Gain (R145) for an exact four-division display.

e. Move the test signal cable from the CH 1 OR X input connector to the CH 2 OR Y input connector.

f. Set the Vertical MODE switch to CH 2.

g. Center the display within the graticule using the CH 2 POSITION control.

h. ADJUST—Ch 2 Gain (R195) for an exact four-division display.

i. Repeat parts b through h until the gain of the two channels is identical. (You must switch the Vertical MODE between CH 1 and CH 2 as needed to view the display.)

j. Change the generator output to 2 mV and set CH 1 and CH 2 Vertical magnification to X10 (pull CAL knobs out).

k. ADJUST—CH 2 X10 Gain (R162) for an exact four-division display.

l. Move the test signal cable from the CH 2 OR Y input connector to the CH 1 OR X input connector.

m. Set the Vertical MODE switch to CH 1.

n. ADJUST—CH 1 X10 Gain (R112) for an exact four-division display.

5. Check Deflection Accuracy and VOLTS/DIV Variable Range

a. Set:

Vertical Magnification (both)	X1 (CAL knobs in)
VOLTS/DIV Variable	CAL detent

b. CHECK—Deflection accuracy is within the limits given in Table 5-3 for each CH 1 VOLTS/DIV switch setting and corresponding standard-amplitude signal. When at the 20 mV VOLTS/DIV switch setting, rotate the CH 1 VOLTS/DIV Variable control fully counterclockwise and CHECK that the display decreases to two divisions or less. Then return the CH 1 VOLTS/DIV Variable control to the CAL detent and continue with the 50 mV check.

c. Move the test signal cable from the CH 1 OR X input connector to the CH 2 OR Y input connector. Set the VERTICAL MODE switch to CH 2.

d. Repeat part b using the Channel 2 controls.

6. Check Input Coupling

a. Set the AC-GND-DC switches (both channels) to GND.

b. Position the trace on the center horizontal graticule line using the CH 2 POSITION control.

c. Change the generator output to 50 mV.

d. Set the Channel 2 AC-GND-DC switch to AC.

e. CHECK—That the Display is centered about the center horizontal graticule line.

Table 5-3
Deflection Accuracy Limits

VOLTS/DIV Switch Setting	Standard Amplitude Signal	Accuracy Limits (Divisions)
5 mV	20 mV	3.88 to 4.12
10 mV	50 mV	4.85 to 5.15
20 mV	0.1 V	4.85 to 5.15
50 mV	0.2 V	3.88 to 4.12
0.1 V	0.5 V	4.85 to 5.15
0.2 V	1 V	4.85 to 5.15
0.5 V	2 V	3.88 to 4.12
1 V	5 V	4.85 to 5.15
2 V	10 V	4.85 to 5.15
5 V	20 V	3.88 to 4.12

f. Set the Channel 2 AC-GND-DC switch to DC.

g. CHECK—that the Display is ground referenced on the center horizontal graticule line.

h. Move the test-signal cable from the CH 2 OR Y input connector to the CH 1 OR X input connector.

i. Set the Vertical MODE switch to CH 1.

j. Repeat parts b through g using the Channel 1 controls.

7. Check Position Range

a. Set:

VOLTS/DIV (both)	10 mV
AC-GND-DC (both)	AC
SEC/DIV	0.2 ms
Trigger COUPLING	AC

b. Set the calibration generator for 0.1 V.

c. Adjust the CH 1 VOLTS/DIV Variable control to produce a 5.25-division display.

d. Set CH 1 VOLTS/DIV to 5 mV.

e. Set the calibration generator to produce a 0.2 V signal.

f. CHECK—the bottom and top of the trace may be positioned above and below the center horizontal graticule line by rotating the CH 1 POSITION control fully clockwise and counterclockwise respectively.

g. Move the test-signal cable from the CH 1 OR X input connector to the CH 2 OR Y input connector.

h. Set the Vertical MODE switch to CH 2.

i. Repeat parts b through f using the Channel 2 controls.

j. Disconnect the test equipment from the instrument.

8. Adjust X1/X10 Balance

a. Set:

Vertical MODE	CH 1
AC-GND-DC (both)	GND
Vertical CAL knob (both)	CAL detent

b. Position the trace on the center horizontal graticule line using the CH 1 POSITION control.

c. Set CH 1 VOLTS/DIV Variable knob to X10 (pull CAL knob out).

d. ADJUST—X10 BAL (R107) to position the trace on the center horizontal graticule line.

e. Set CH 1 VOLTS/DIV variable knob to X1 (push CAL knob in).

f. Repeat parts b through e until there is no trace shift between X1 and X10 positions.

g. Set Vertical MODE to CH 2.

h. Repeat parts b through f for CH 2, using the Channel 2 X10 BAL adjust (R157) instead of R107 in part d.

i. Return both VOLTS/DIV variable controls to their CAL and X1 positions.

9. Adjust Attenuator Compensation

a. Set:

VOLTS/DIV (both)	10 mV
Vertical Magnification (both)	X1 (CAL knobs in)
AC-GND-DC (both)	DC

b. Connect the high-amplitude square-wave output from the calibration generator via a probe tip-to-

BNC adapter, and the 10X probe to the CH 2 OR Y input connector.

c. Set the generator for a 1 kHz, five-division display and compensate the probe using the probe compensation adjustment (see the probe instruction manual).

d. Replace the probe and probe-tip-to-BNC adapter with a 50-Ω BNC coaxial cable and 50-Ω BNC termination.

e. Set the generator to produce a five-division display.

f. ADJUST—Trimmer 1 for flattest response on square-wave signal. See Figure 5-1 for location of trimmers.

g. Replace the 50-Ω BNC coaxial cable and 50-Ω BNC termination with a probe and a probe-tip-to-BNC adapter.

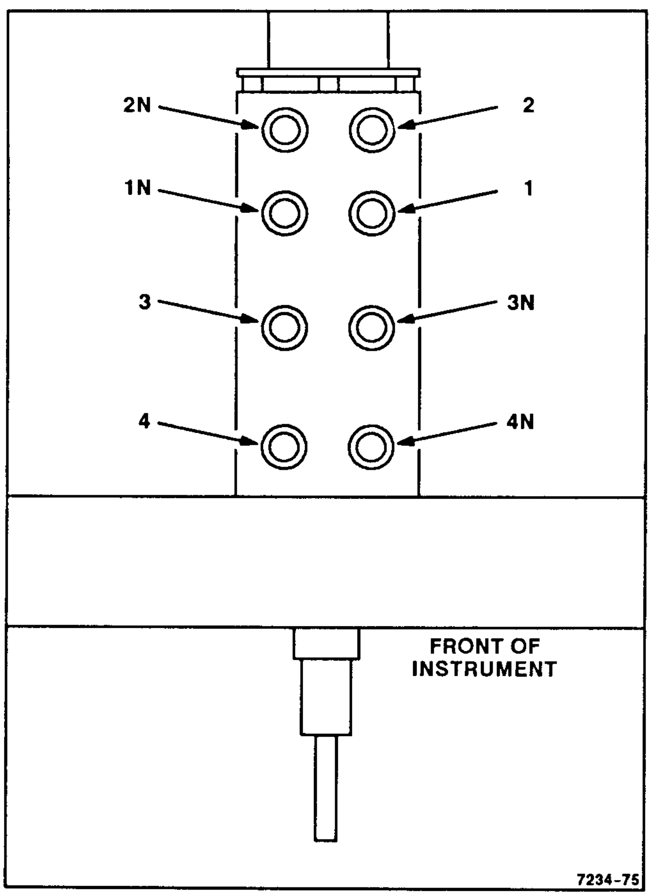


Figure 5-1. Trimmer layout.

h. Set the generator to produce a five-division square wave.

i. ADJUST—Trimmer 1N for flattest response on square wave.

j. Set the CH 2 VOLTS/DIV switch to 20 mV.

k. Repeat parts d through i except adjust '2' and '2N' trimmers in parts f and i respectively.

l. Set the CH 2 VOLTS/DIV switch to 50 mV.

m. Repeat parts d through i except adjust '3' and '3N' trimmers in parts f and i respectively.

n. Set the CH 2 VOLTS/DIV switch to 0.5 V.

o. Repeat parts d through i except adjust '4' and '4N' trimmers in parts f and i respectively.

p. Set the Vertical MODE switch to CH 1.

q. Repeat parts b through o for Channel 1 attenuators.

r. Disconnect the test equipment from the instrument.

10. Check Vertical ALT Operation

a. Set:

AC-GND-DC (both)	GND
Vertical MODE	BOTH, NORM, and ALT
SEC/DIV	0.1 s
Trigger SOURCE	CH 1

b. Position the Channel 1 and Channel 2 traces about 2 divisions apart using the CH 1 and CH 2 POSITION controls.

c. CHECK—Channel 1 and Channel 2 traces move across the screen alternately.

11. Check CHOP Operation

a. Set:

Vertical MODE	BOTH, NORM, and CHOP
SEC/DIV	1 μs
Trigger MODE	NORM
Trigger SOURCE	VERT MODE

b. ADJUST—Chop Switch Balance (R140) for no triggering on chop segments when rotating the Trigger LEVEL control.

12. Check ADD MODE Operation

a. Set:

VOLTS/DIV (both)	20 mV
Vertical MODE	BOTH, NORM, and ALT
SEC/DIV	0.5 ms
Horizontal MAG	X1
Trigger SOURCE	CH 1
AC-GND-DC (both)	DC

b. Position both traces on the center horizontal graticule line using the CH 1 and CH 2 POSITION controls.

c. Set the calibration generator for a 50 mV signal.

d. Connect the output of the calibration generator to both the CH 1 OR X and CH 2 OR Y input connectors with a dual-input coupler.

e. CHECK—that both channels show a 2.5 division display.

f. Set:

Vertical MODE	ADD
AC-GND-DC (both)	AC

g. CHECK—that the resultant display is 5 divisions ±3% (4.85 to 5.15).

h. Disconnect the test equipment from the instrument.

NOTE

Before carrying out adjustment 13, turn to the section covering Cursor and Readout Adjustments and perform Adjustment 2, Adjust Readout Jitter, if necessary.

13. Adjust High-Frequency Compensation

a. Set:

VOLTS/DIV (both)	10 mV
Vertical MODE	CH 1
SEC/DIV	0.2 μs

b. Connect the positive-going fast-rise square wave output from the calibration generator via a 50-Ω BNC coaxial cable, a 10X BNC attenuator, and a 50-Ω BNC termination to the CH 1 OR X input connector.

c. Set the generator to produce a 1 MHz, five-division display.

d. Set the top of the display to the center horizontal graticule line using the CH 1 POSITION control.

e. ADJUST—Compensation (R241, R240, C256, C237 and C257) for flattest response. Repeat adjustments until no further improvements are noted.

f. Move the test signal to CH 2 and set the Vertical MODE to CH 2.

g. ADJUST—CH 2 compensation capacitor C180 to match the CH 2, 10 mV compensation of the CH 1 10 mV compensation.

h. Move the test signal cable back to CH 1 and set the Vertical MODE to CH 1.

i. Set the CH 1 VOLTS/DIV to 5 mV.

j. Set the generator for a five-division signal.

k. CHECK—for aberrations ±6% (0.3 division) or less.

l. Set CH 1 VOLTS/DIV to 10 mV.

m. Set the generator for a five-division signal.

n. CHECK—for aberrations ±4% (0.2 division) or less.

o. Repeat part n for each CH 1 VOLTS/DIV switch settings from 20 mV through 0.2 V. Adjust the generator output and add or remove the 10X attenuator as necessary to maintain a five-division display at each VOLTS/DIV switch setting.

NOTE

Some generators do not produce enough signal amplitude to test above 0.2 volts/div. Omit steps p through t, if necessary.

p. Set the CH 1 VOLTS/DIV switch to 0.5 V.

q. CHECK—for aberrations of ±6% (0.3 division) or less.

r. Set the CH 1 VOLTS/DIV switch to 1 V.

s. CHECK—for aberrations of ±12% (0.6 division) or less.

t. Repeat part s for the 2 V and 5 V CH 1 VOLTS/DIV switch settings. Adjust the generator output and add or remove the 10X attenuator as necessary to maintain a five-division display at each VOLTS/DIV switch setting.

u. Move the cable from the CH 1 OR X input connector to the CH 2 OR Y input connector. Set the Vertical MODE switch to CH 2.

v. Repeat parts i through t for Channel 2.

w. Disconnect the test equipment from the instrument.

14. Check NON-STORE Bandwidth

a. Set:

VOLTS/DIV (both)	5 mV
Vertical MODE	CH 1
SEC/DIV	10 μs
Trigger SOURCE	VERT MODE

b. Connect the leveled sine-wave generator output via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input connector.

c. Set the generator to produce a 50 kHz, six-division display.

d. Increase the sine-wave frequency until a 4.2 division display is obtained.

e. CHECK — the frequency is greater than 50 MHz.

f. Repeat parts c through e for all ranges from 10 mV to 0.5 V.

g. Set:

CH 1 VOLTS/DIV	5 mV
CH1 VOLTS/DIV Variable	X10 (CAL knob out)

h. Set the generator to produce a 50 kHz, six-division display.

i. Increase the signal frequency until a 4.2 division display is obtained.

j. CHECK — the frequency is greater than 5 MHz.

k. Repeat parts h through j for all ranges from 10 mV to 0.5 V.

l. Set the CH 1 VOLTS/DIV Variable to X1 (push CAL knob in).

m. Set Vertical MODE to CH 2.

n. Repeat parts b through j for CH 2.

15. Check Channel Isolation

a. Set:

VOLTS/DIV (CH 1)	0.5 V
VOLTS/DIV (CH 2)	1 V
AC-GND-DC (CH 2)	DC
AC-GND-DC (CH 1)	GND
SEC/DIV	0.05 μs

b. Set the generator to produce a 5-division peak-to-peak display at 10 MHz.

c. Set CH 2 VOLTS/DIV to 0.5 V for a 10-division display.

d. Set Vertical MODE to CH 1.

e. CHECK — that the display amplitude is less than 0.1 division.

f. Move the test-signal cable from the CH 2 OR Y input connector to the CH 1 OR X input connector.

g. Set:

Vertical MODE	CH 2
CH 1 AC-GND-DC	DC
CH 2 AC-GND-DC	GND

h. CHECK — that the display amplitude is less than 0.1 division.

i. Disconnect the test equipment from the instrument.

16. Common Mode Rejection Ratio

a. Set:

VOLTS/DIV (both)	10 mV
AC-GND-DC (both)	DC

b. Connect the leveled sine-wave generator output via a 50-Ω BNC coaxial cable a 50-Ω BNC termination, and a dual-input coupler to the CH 1 OR X and CH 2 OR Y input connectors.

c. Set the generator to produce a 20 MHz, six-division display.

d. Set Vertical MODE to BOTH, CH 2 INVERT and ADD.

e. CHECK — that the ADD display is less than 0.6 division.

f. Disconnect the test equipment from the instrument.

HORIZONTAL

Equipment Required (See Table 4-1):

Calibration Generator (Item 1)	Test Oscilloscope (Item 7)
Leveled Sine-Wave Generator (Item 2)	50-Ω Coaxial Cable (Item 9)
Time-Mark Generator (Item 3)	50-Ω BNC Termination (Item 11)
Screwdriver (Item 6)	Low-Reactance Alignment tool (Item 16)

INITIAL CONTROL SETTINGS

Vertical

POSITION (both)	Midrange
MODE	CH 1
VOLTS/DIV (both)	0.5 V
VOLTS/DIV Variable (both)	CAL detent
Magnification (both)	X1 (CAL knobs in)
AC-GND-DC (both)	DC

Horizontal

POSITION (COARSE and FINE)	Midrange
SEC/DIV	1 ms
SEC/DIV Variable	CAL detent
MAG	X1

Trigger

SLOPE	POSITIVE (_/‾)
LEVEL	Midrange
MODE	P-P AUTO
HOLDOFF	MIN
SOURCE	CH 1
COUPLING	AC

Storage

STORE/NON-STORE	NON-STORE

PROCEDURE STEPS

1. Adjust 1 ms Timing (R775)

a. Connect 1 ms time markers from the time-mark generator via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input connector.

b. Align the first time marker with the first (extreme left) vertical graticule line using the Horizontal POSITION control.

NOTE

When making timing measurements, use the tips of the time markers positioned at the center horizontal graticule line as the measurement reference points.

c. ADJUST—X1 gain (R775) for one marker per division over the center eight divisions.

2. Adjust Magnifier Gain (R731, R777)

a. Set:

Horizontal MAG	X10

b. Set the time-mark generator for 0.1 ms time markers.

c. Align the first time marker with the first (extreme left) vertical graticule line using the Horizontal POSITION control.

d. ADJUST—X10 Mag Gain (R777) for 10 divisions between magnified markers.

e. Set the time-mark generator for 20 μs time markers.

f. ADJUST—X50 Mag Gain (R731) for 1 marker per division.

3. Adjust Magnifier Registration (R782, R730)

a. Set the Horizontal MAG to X50 and switch the time-mark generator for 1 ms time markers.

b. Position the first time marker to the center vertical graticule line using the Horizontal POSITION controls.

c. Set Horizontal MAG to X10.

d. ADJUST—X50 Mag Reg (R730) to bring first time marker to the center vertical graticule line.

e. Set the Horizontal MAG control to X1.

f. ADJUST—X10 Mag Reg (R782) to overlay the first magnified marker onto the center vertical graticule line.

4. Check Sweep Length

a. Set:

SEC/DIV	0.1 ms
Horizontal MAG	X1

b. Select 0.1 ms time markers from the time-mark generator.

c. Position the start of the sweep at the first vertical graticule line using the Horizontal POSITION controls.

d. CHECK—that the sweep length is between 10.2 and 12 divisions.

5. Check Position Range

a. CHECK—that the start of the sweep can be positioned to the right of the center vertical graticule line by rotating the COARSE Horizontal POSITION control fully clockwise.

b. CHECK—that the tenth time marker can be positioned to the left of the center vertical graticule line by rotating the COARSE Horizontal POSITION control fully counterclockwise.

c. CHECK—that the FINE Horizontal POSITION control can move the trace more than 0.4 division.

6. Check Variable Range

a. Select 0.5 ms time markers from the time-mark generator.

b. Set the SEC/DIV Variable control fully counterclockwise.

c. CHECK—that the spacing between time markers is two divisions or less.

d. Return SEC/DIV Variable to detent.

7. Adjust 10 μs & 5 μs Timing (R722, C703)

a. Set the SEC/DIV switch to 10 μs.

b. Select 10 μs time markers from the time-mark generator.

c. ADJUST—10 μs Timing (R722) for one marker per division.

d. Set SEC/DIV switch to 5 μs.

e. Select 5 μs time markers from the time-mark generator.

f. ADJUST—5 μs timing (C703) for one marker per division.

8. Adjust High-Speed Timing (C784, C794)

a. Set:

CH 1 VOLTS/DIV	0.1 V
CH 1 AC-GND-DC	AC
SEC/DIV	0.05 μs
Horizontal MAG	X10
Trigger SOURCE	EXT, EXT

b. Select 10 ns time markers from the time-mark generator.

c. Connect the time marker trigger out via a 50-Ω BNC coaxial cable and a 50-Ω terminator to the EXT OR Z input connector.

d. Adjust the Trigger LEVEL controls so that the markers are stably triggered.

e. ADJUST—5 ns Linearity (C784) and 5 ns Timing (C794) for two divisions between each marker.

9. Check Timing Accuracy and Linearity

a. Set:

CH 1 VOLTS/DIV	0.5 V
SEC/DIV	0.05 μs
Horizontal MAG	X1

b. Select 50 ns time markers from the time-marker generator.

c. Adjust the TRIGGER LEVEL control for a stable, triggered display.

d. Use the Horizontal POSITION controls to align the second time marker with the second vertical graticule line.

e. CHECK—Timing accuracy is within 3% (0.24 division at the tenth vertical graticule line), and linearity is within 5% (0.10 division over any two of the center eight divisions).

NOTE

When checking the timing accuracy of the SEC/DIV switch settings from 50 ms to 0.5 s, watch the time marker tips only at the second and tenth vertical graticule lines while adjusting the Horizontal POSITION controls.

f. Repeat parts c through e for the remaining SEC/DIV and time-mark generator setting combinations shown in Table 5-4 under the "Normal" column.

NOTE

In X50 magnification in all "2" decade switch settings, the associated time marker settings give only five markers per 10 divisions instead of the customary 10. When checking these ranges, position the markers on the second and ninth vertical graticule lines.

g. Disconnect the test signal from the EXT INPUT OR Z connector.

h. Set:

SEC/DIV	0.1 μs
Horizontal MAG	X10

i. Select 10 ns time markers from the time-marker generator.

Table 5-4
Settings for Timing Accuracy Checks

SEC/DIV Switch Setting	Time-Mark Generator Setting		
	Normal	X10 Mag	X50 Mag
0.05 μs	50 ns	10 ns	
0.1 μs	0.1 μs	10 ns	
0.2 μs	0.2 μs	20 ns	
0.5 μs	0.5 μs	50 ns	10 ns
1 μs	1 μs	0.1 μs	20 ns
2 μs	2 μs	0.2 μs	0.1 μs
5 μs	5 μs	0.5 μs	0.1 μs
10 μs	10 μs	1 μs	0.2 μs
20 μs	20 μs	2 μs	1 μs
50 μs	50 μs	5 μs	1 μs
0.1 ms	0.1 ms	10 μs	2 μs
0.2 ms	0.2 ms	20 μs	10 μs
0.5 ms	0.5 ms	50 μs	10 μs
1 ms	1 ms	0.1 ms	20 μs
2 ms	2 ms	0.2 ms	0.1 ms
5 ms	5 ms	0.5 ms	0.1 ms
10 ms	10 ms	1 ms	0.2 ms
20 ms	20 ms	2 ms	1 ms
50 ms	50 ms	5 ms	1 ms
0.1 s	0.1 s	10 ms	2 ms
0.2 s	0.2 s	20 ms	10 ms
0.5 s	0.5 s	50 ms	10 ms

j. Use the Horizontal POSITION controls to align the first time marker that is 50 ns beyond the start of the sweep with the second vertical graticule line.

k. CHECK—timing accuracy is within 4% (0.32 division at the tenth vertical graticule line), and linearity is within 7% (0.14 division over any two of the center eight divisions). Exclude any portion of the sweep past the 50th magnified division.

l. Repeat parts j and k for the remaining SEC/DIV and time-mark generator setting combinations shown in Table 5-4 under the "X10 Mag" column.

m. Set:

SEC/DIV	0.5 μs
Horizontal MAG	X50

n. Select 10 ns time markers from the time-marker generator.

o. Use the Horizontal POSITION control to align the first time marker that is 100 ns beyond the start of the sweep with the second vertical graticule line.

p. CHECK—timing accuracy is within 5% (0.40 division at the tenth vertical graticule line), and linearity is within 9% (0.18 division over any two of the center eight divisions). Exclude any portion of the sweep past the 100th magnified division.

q. Repeat parts o and p for the remaining SEC/DIV and time-mark generator setting combinations shown in Table 5-4 under the "X50 Mag" column.

r. Disconnect the test equipment from the instrument.

10. Adjust X-Y Gain & Offset (R395, R736)

a. Set:

VOLTS/DIV (both)	10 mV
SEC/DIV	X-Y (fully counter clockwise)
Horizontal MAG	X1

b. Connect 50 mV standard amplitude signal from the calibration generator via a 50-Ω BNC coaxial cable to the CH 1 OR X input connector.

c. ADJUST—X Gain (R395) for an exact five-division display.

d. Center the display within the graticule using the Channel 1 POSITION control.

e. Set:

CH 1 AC-GND-DC	GND
SEC/DIV	1 ms

f. Align the start of the trace with the first (extreme left) vertical graticule line using the Horizontal POSITION controls.

g. Set the SEC/DIV switch to X-Y (fully counter-clockwise).

h. ADJUST—X Centering (R736) to position the spot at the seventh vertical graticule line (sixth division to the right).

i. Disconnect the test equipment from the instrument.

11. Check X Bandwidth

a. Set:

VOLTS/DIV (both)	50 mV
AC-GND-DC (both)	DC
Vertical MODE	BOTH, NORM, and ALT
Trigger SOURCE	CH 1

b. Connect the leveled sine-wave generator output via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input connector.

c. Set the generator to produce an eight-division horizontal display at an output frequency of 50 kHz.

d. Increase the generator output frequency until the horizontal deflection (X axis) is equal to 5.7 divisions in length.

e. CHECK—that the frequency is greater than 2 MHz.

f. Disconnect the test equipment from the instrument.

12. Check Sweep Holdoff

a. Set:

VOLTS/DIV (both)	1 V
AC-GND-DC (both)	GND
Vertical MODE	CH 1
SEC/DIV	1 ms
Trigger SOURCE	EXT, EXT

b. Connect the test oscilloscope's 10X probe tip to the front end of R704 (toward the front panel). R704 is located on the Attenuator circuit board.

c. Set the HOLDOFF control fully counterclockwise (MIN setting).

d. Measure the HOLDOFF time.

e. Rotate the HOLDOFF control to the fully clockwise position.

f. CHECK—the Sweep holdoff has increased by at least a factor of eight.

g. Repeat parts c through f for SEC/DIV settings of 0.5 ms and 5 μs.

h. Disconnect the 10X probe from R704.

TRIGGER

Equipment Required (See Table 4-1):

Leveled Sine-Wave Generator (Item 2)
Low-Frequency Sine-Wave Generator (Item 4)
Screwdriver (Item 6)
50-Ω BNC Coaxial Cable (Item 9)
Dual-Input Coupler (Item 10)
50-Ω BNC Termination (Item 11)
600-Ω BNC Termination (Item 12)

INITIAL CONTROL SETTINGS

Vertical

POSITION	Midrange
MODE	BOTH, NORM, and ALT
VOLTS/DIV (both)	50 mV
VOLTS/DIV Variable (both)	CAL detent
Magnification (both)	X1 (CAL knobs in)
AC-GND-DC (both)	DC

Horizontal

POSITION (COARSE and FINE)	Midrange
MAG	X1
SEC/DIV	2 μs
SEC/DIV Variable	CAL detent

Trigger

SLOPE	Positive (⌐)
LEVEL	Midrange
MODE	P-P AUTO
HOLDOFF	MIN
SOURCE	VERT MODE
COUPLING	DC

Storage

NON-STORE/STORE	NON-STORE

PROCEDURE STEPS

1. Adjust Trigger Offset Channel Balance (R338)

a. Connect the leveled sine-wave generator output via a 50-Ω BNC coaxial cable, a 50-Ω BNC termination, and a dual-input coupler to the CH 1 OR X input connector and the CH 2 OR Y input connectors.

b. Set the generator to produce a four-division horizontal display at an output frequency of 50 kHz.

c. Center the CH 1 and CH 2 traces vertically.

d. Adjust the variable SEC/DIV control to give one and a half sine wave periods across the graticule.

e. ADJUST—CH 1/CH 2 Balance (R338) (found under the Attenuator board) until the sine waves coincide.

f. Return the SEC/DIV variable control to detent (CAL) position.

2. Adjust Trigger Hysteresis, Slope Balance Offset and P-P Offset (R489, R481 and R478)

a. Set:

CH 1 VOLTS/DIV	0.1 V
Vertical MODE	CH 1
SEC/DIV	20 μs
Trigger SOURCE	CH 1

b. Connect the leveled sine-wave generator output via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input connector.

c. Set the generator to produce a 2.2-division horizontal display at an output frequency of 50 kHz.

d. Set:

CH 1 VOLTS/DIV	1 V
Trigger MODE	NORM

e. ADJUST—R489 and the Trigger LEVEL control for minimum sensitivity with a stable trigger.

NOTE

Adjusting Trigger Sensitivity (R489) clockwise decreases trigger sensitivity.

f. ADJUST—Slope Bal (R481) and the Trigger LEVEL control so that a reliable trigger can be maintained when switching the Trigger SLOPE switch between positive and negative.

g. Adjust Trigger LEVEL control for stable trigger.

h. Set Trigger MODE to P-P AUTO.

i. ADJUST—P-P AUTO (R478) until a stable trigger can be obtained when switching the trigger SLOPE switch between positive and negative.

3. Check Trigger Sensitivity

a. Set:

Channel 1 VOLTS/DIV	0.1 V
Channel 2 VOLTS/DIV	1 V
AC-GND-DC (both)	AC
Vertical MODE	BOTH, NORM, and ALT
SEC/DIV	0.2 μs

b. Set the generator to produce a three-division display at an output frequency of 5 MHz.

c. Set CH 1 VOLTS/DIV switch to 1 V.

d. CHECK—Stable display can be obtained by adjusting the TRIGGER LEVEL control for each switch combination given in Table 5-5. negative slopes. Ensure that the TRIG'D light comes on when triggered.

Table 5-5

Switch Combinations for Triggering Checks

Trigger MODE	Trigger SLOPE
NORM	Positive ⎍
NORM	Negative ⎍
P-P AUTO	Positive ⎍
P-P AUTO	Negative ⎍

e. Set the generator to produce a 1 division display at an output frequency of 50 MHz.

f. Repeat part d.

g. Move the test-signal cables from the CH 1 OR X input connector to the CH 2 OR Y input connector. Set the Vertical MODE switch to CH 2.

h. Repeat part b.

i. Repeat part d.

j. Repeat part e.

k. Disconnect the test equipment from the instrument.

l. Set:

CH 1 VOLTS/DIV	10 mV
Vertical MODE	CH 1
SEC/DIV	0.2 μs
Trigger MODE	P-P AUTO
Trigger SOURCE	EXT, EXT

m. Connect the leveled sine-wave generator output via a 50-Ω BNC coaxial cable, a 50-Ω BNC termination and a dual-input coupler to the CH 1 OR X input connector and EXT INPUT OR Z input connectors.

n. Set the generator to produce a four-division (40 mV) display at an output frequency of 5 MHz.

o. Repeat part d.

p. Disconnect the test equipment from the instrument.

4. Check LF P-P AUTO Trigger

a. Set:

CH 1 VOLTS/DIV	0.1 V
SEC/DIV	20 ms
Trigger MODE	P-P AUTO
Trigger SOURCE	CH 1
Trigger SLOPE	Positive (⎍)

b. Connect the low-frequency generator output via a 50-Ω BNC coaxial cable and a 600-Ω BNC termination to the CH 1 OR X input connector.

c. Set the low-frequency sine-wave generator output to produce a 20 Hz one-division display.

d. CHECK—For stable triggering in both positive and negative slopes. Ensure that the TRIG'D light comes on when triggered.

5. Check LF Reject

a. Set:

Horizontal MAG	X1
SEC/DIV	10 μs
Vertical MODE	CH 2 , NORM
CH 2 VOLTS/DIV	1.0 V, AC COUPLED
Trigger MODE	P-P AUTO
Trigger SLOPE	Positive (_/‾)
Trigger COUPLING	LF REJECT

b. Set calibration generator for 10 kHz squarewave.

c. Connect generator output to CH 2 input connector.

d. Adjust the generator output to display a 3 division waveform.

e. Set Trigger MODE to NORM.

f. Adjust Trigger LEVEL control fully clockwise.

g. Rotate Trigger LEVEL control counterclockwise until waveform just triggers.

h. Set CH 2 VOLTS/DIV to 50 mV and Horizontal MAG to X10.

i. Position vertical transition to right hand side of screen.

j. CHECK—that when switching the Trigger SLOPE switch from positive to negative, the vertical transition is advanced horizontally by 3.2 to 5.2 divisions.

6. Check HF Reject

a. Set Trigger SLOPE to positive, Trigger COUPLING to DC and Trigger MODE to NORM.

b. Adjust Trigger LEVEL for stable trigger.

c. Adjust Horizontal POSITION control to set vertical transition after 10 divisions of sweep, to the center vertical graticule line.

d. Set Trigger COUPLING to HF REJECT.

e. ADJUST Trigger LEVEL control so that when switching the Trigger SLOPE switch between positive and negative, the vertical transition does not move horizontally by more than 0.2 divisions.

f. CHECK—that when switching the Trigger COUPLING switch between DC and HF REJECT, the vertical transition is advanced horizontally by 3.1 to 5.1 divisions.

7. Adjust External Trigger Balance & Range

a. Set:

CH 1 VOLTS/DIV	0.1 V
CH 1 AC-GND-DC	DC
Vertical MODE	CH 1
Horizontal MAG	X1
SEC/DIV	20 μs
Trigger MODE	P-P AUTO
Trigger SOURCE	CH 1
Trigger COUPLING	AC
Trigger SLOPE	Positive (_/‾)

b. Connect the leveled sine-wave generator output via a 50 Ω BNC coaxial cable, a 50 Ω BNC termination, and a dual-input coupler to both the CH 1 OR X and EXT INPUT or Z input connectors.

c. Set the leveled sine-wave generator to produce a 50 kHz, five division display.

d. Position the waveform equally about the center horizontal graticule line.

e. Set Trigger MODE to NORM.

f. Adjust the TRIG LEVEL control to set the start of the trace to the center horizontal graticule line.

g. Set Trigger SOURCE to EXT.

h. ADJUST—Ext Trig Offset (R360) to return the start of the trace to the center horizontal graticule line.

i. CHECK—that when switching between CH 1 and EXT Trigger SOURCES that the start of the trace does not change.

j. Set the CH 2 VOLTS/DIV to 0.5 V and the Trigger SOURCE to EXT.

k. Adjust the leveled sine-wave generator output to give a 5-division display.

l. CHECK—that the display can be untriggered at either end of the Trigger LEVEL control.

m. Set the Trigger SOURCE switch to EXT/10.

n. CHECK—that the display can be triggered about the mid-range of the Trigger LEVEL control.

o. Set the Trigger SLOPE switch to Negative (⌐_) and repeat part n.

p. Disconnect the test equipment from the instrument.

8. Check Single Sweep Operation

a. Set:

CH 1 VOLTS/DIV	10 mV
CH 1 AC-GND-DC	DC
Vertical MODE	CH 1
SEC/DIV	0.5 ms
Horizontal MAG	X1
Trigger MODE	NORM
Trigger SOURCE	CH 1
Trigger COUPLING	AC
Trigger Slope	Positive (_⌐)

b. Connect a 50 mV standard amplitude signal from the calibration generator via a 50 Ω BNC coaxial cable to the CH 1 OR X input connector.

c. Adjust the Trigger LEVEL control to obtain a stable display.

d. Set:

CH 1 AC-GND-DC	GND
Trigger MODE	SGL SWP

e. Press in SGL SWP RESET button. The READY light should turn on and remain lit.

f. Set the Channel 1 AC-GND-DC switch to DC.

NOTE

The INTENSITY control may require adjustment to observe the single-sweep trace.

g. CHECK—READY light goes out and single sweep occurs.

h. Press in the SGL SWP RESET button several times.

i. CHECK—Single-sweep trace occurs, and the READY light turns on briefly every time the SGL SWP RESET button is pressed.

9. Adjust Trigger Readout

a. Set:

Vertical MODE	CH 1
CH 1 VOLTS/DIV	0.1 V, DC COUPLED
Horizontal MAG	X1
SEC/DIV	20 μs
TRIGGER MODE	P-P AUTO
TRIGGER SOURCE	CH 1
TRIGGER COUPLING	DC
READOUT	"ON"

b. Connect the leveled sine-wave generator output via a 50 Ω BNC termination to the CH1 OR X input connector.

c. Set the generator to produce an 8 division vertical display at an output frequency of 50 kHz.

d. Adjust the CH 1 POSITION control to center the trace about the center horizontal graticule line. Set TRIG MODE to NORM.

f. Set the Trigger SLOPE switch to Positive (_⌐).

g. ADJUST R1347 to set the trigger readout to 0.00V.

h. ADJUST the CH 1 POSITION control so that the start of the trace is aligned with the center horizontal graticule line.

i. ADJUST the Trigger LEVEL control so that the trace starts 1 division above the center horizontal graticule line.

j. ADJUST R1344 to set the trigger readout to +0.10V.

k. Using the TRIG LEVEL control, check that when the trace starts 2 divisions above the center horizontal graticule line, that the trigger readout is +0.20V, and for 3 divisions it is +0.30V.

l. CHECK that when the trace starts 1 division below the center horizontal graticule line that the readout is -0.10V, for 2 divisions it is -0.20V, and for 3 divisions it is -0.30V.

m. Repeat steps f through j if steps k or l fail.

n. ADJUST the CH 1 POSITION control to center the trace about the center horizontal graticule line.

o. ADJUST the Trigger LEVEL control so that the trace starts equally about the center horizontal graticule line when switching between Positive (_⌐) and Negative (⌐_) Trigger SLOPES.

p. Set the Trigger SLOPE switch to Negative (⌐_) .

q. Adjust the CH1 POSITION control so that the start of the trace is aligned with the center horizontal graticule line.

r. Repeat steps k and l.

EXTERNAL Z-AXIS AND PROBE ADJUST

Equipment Required (See Table 4-1):

Leveled Sine-Wave Generator (Item 2)
Screwdriver (Item 6)
50-Ω BNC Coaxial Cable (Item 9)
Dual-Input Coupler (Item 10)
50-Ω BNC Termination (Item 11)
10X Probe (Provided with instrument)

INITIAL CONTROL SETTINGS

Vertical

Channel 1 POSITION	Midrange
MODE	CH 1
CH 1 VOLTS/DIV	1 V
CH 1 VOLTS/DIV Variable	CAL detent
Magnification	X1 (CAL knob in)
CH 1 AC-GND-DC	DC

Horizontal

POSITION (COARSE and FINE)	Midrange
MAG	X1
SEC/DIV	20 μs
SEC/DIV Variable	CAL detent

Trigger

SLOPE	Positive (_/‾)
LEVEL	Midrange
MODE	P-P AUTO
HOLDOFF	MIN
SOURCE	EXT, EXT=Z
COUPLING	DC

Storage

NON-STORE/STORE	NON-STORE

PROCEDURE STEPS

1. Check External Z-Axis Operation

a. Connect the leveled sine-wave generator output via a 50-Ω BNC coaxial cable, 50-Ω terminator, and a dual-input coupler to the CH 1 OR X input connector and EXT INPUT OR Z input connectors.

b. Set the generator to produce a five-division 50 kHz signal.

c. CHECK—for noticeable intensity modulation. The positive part of the sine wave should be of lower intensity than the negative part.

d. Disconnect the test equipment from the instrument.

2. Check Probe Adjust Operation

a. Set:

CH 1 VOLTS/DIV	10 mV
SEC/DIV	0.5 ms
Trigger SOURCE	CH 1

b. Connect the 10X Probe to the CH 1 OR X input connector and clip the probe tip to the PROBE ADJUST terminal on the instrument front panel. If necessary, adjust the probe compensation for a flat-topped square-wave display (see probe instruction manual).

c. CHECK—display amplitude is 4.75 to 5.25 divisions.

d. Disconnect the probe from the instrument.

STORAGE

Equipment Required (See Table 4-1):

Calibration Generator (Item 1)
Leveled Sine-Wave Generator (Item 2)
Time-Mark Generator (Item 3)
Low-Frequency Sine-Wave Generator (Item 4)
Pulse Generator (Item 5)
50-Ω BNC Coaxial Cable (Item 9)
Dual-Input Coupler (Item 10)
50-Ω BNC Termination (Item 11)
600-Ω Termination (Item 12)
10X Attenuator (Item 13)
2X Attenuator (Item 14)

INITIAL CONTROL SETTINGS

Vertical

POSITION (both)	Midrange
MODE	CH 1, NORM
VOLTS/DIV (both)	5 mV
VOLTS/DIV Variable (both)	CAL detent
Magnification	X1 (CAL knobs in)
AC-GND-DC (both)	GND

Horizontal

POSITION (COARSE and FINE)	Midrange
MAG	X1
SEC/DIV	0.2 ms
SEC/DIV Variable	CAL detent

Trigger

SLOPE	Positive (_/‾)
LEVEL	Midrange
MODE	P-P AUTO
HOLDOFF	MIN
SOURCE	EXT, EXT
COUPLING	DC

Storage

STORE/NON-STORE	STORE
PRE-TRIG 25%/75%	75%
ACQ SAVE/CONTINUE	CONTINUE
REFERENCE POSITION	Midrange

PROCEDURE STEPS

1. Adjust Vertical DAC (R1376, R1367, R1382, and R1372)

a. Hold the ΔV and ΔT push buttons in until the Tektronix logo appears on the crt screen.

b. Press the Cursor Position control once and a box with a star inside will appear on the crt screen.

c. ADJUST—R1376 to align the star with the center vertical graticule line.

d. ADJUST—R1367 to align the star with the center horizontal graticule line.

e. ADJUST—R1382 to align the vertical edges of the box with the second and tenth vertical graticule lines.

f. ADJUST—R1372 to align the horizontal edges of the box with the horizontal graticule lines immediately above the bottom graticule line and immediately below the top graticule line.

2. Adjust CH 1 Storage Balance (R1016)

a. Set STORE/NON-STORE to NON-STORE.

b. Position the trace to the center horizontal graticule line using the CH 1 Position control.

c. Set the STORE/NON-STORE switch to STORE.

d. Adjust R1016 on the Storage Board until the trace is positioned on the center horizontal graticule line.

3. Adjust CH 1 Storage Gain

a. Set:

Trigger SOURCE	CH 1
CH 1 AC-GND-DC	DC

b. Connect a 20 mV standard-amplitude signal from the calibration generator via a 50-Ω BNC coaxial cable to the CH 1 OR X input.

c. ADJUST R1001 on the Storage Board until the trace has a height of exactly 4 divisions.

d. Disconnect the test equipment from the instrument.

4. Adjust CH 2 Storage Balance (R1017)

a. Set:

Vertical MODE	CH 2
STORE/NON-STORE	NON-STORE

b. Using the CH 2 POSITION control, position the trace to the center horizontal graticule.

c. Set STORE/NON-STORE to STORE.

d. ADJUST R1017 on the Storage Board until the trace is positioned on the center horizontal graticule.

5. Adjust CH 2 Storage Gain (R1004)

a. Set:

AC-GND-DC (CH 2)	DC
Trigger SOURCE	CH 2

b. Connect a 20 mV standard-amplitude signal from the calibration generator via a 50-Ω BNC coaxial cable to the CH 2 OR Y input.

c. ADJUST R1004 on the Storage Board until the trace has a height of exactly 4 divisions.

d. Disconnect the test signal from the CH 2 OR Y input.

6. Adjust Add Storage Balance (R1036)

a. Set:

Vertical MODE	BOTH, ADD
AC-GND-DC	GND
Trigger SOURCE	EXT, EXT
STORE/NON-STORE	NON-STORE

b. Position the trace to the center horizontal graticule line.

c. Set STORE/NON-STORE to STORE.

d. ADJUST R1036 until the traces are positioned on the center horizontal graticule line.

7. Adjust Add Storage Gain (R1040)

a. Set:

Vertical MODE	CH 2, INV
AC-GND-DC (both)	DC
Trigger SOURCE	CH 1

b. Connect a 20 mV standard-amplitude signal from the calibration generator via a dual-input coupler to both the CH 1 (X) and CH 2 (Y) inputs.

c. ADJUST R1040 on the Storage Board until the trace is straight, i.e., with no square wave.

d. Disconnect the test equipment from the instrument.

8. Check Storage VOLTS/DIV Accuracy

a. Set:

VOLTS/DIV (both)	5 mV
SEC/DIV	0.2 ms
STORE/NON-STORE	NON-STORE

b. Connect a 20 mV standard-amplitude signal from the calibration generator via a 50-Ω BNC coaxial cable to the CH 1 OR X input connector.

c. CHECK—that there is a 4-division signal displayed on the screen.

d. Set:

STORE/NON-STORE	STORE
SAVE/CONTINUE	SAVE

e. CHECK—that the displayed signal amplitude is 4 divisions ±3% (3.88 to 4.12 divisions).

f. Select each VOLTS/DIV setting and corresponding standard-amplitude signal level given in Table 5-6. At each level, select CONTINUE then SAVE to acquire and hold the next test waveform.

g. CHECK—that each new test waveform is displayed within the corresponding accuracy limit given in Table 5-6.

h. Set the calibration generator to output 20 mV.

i. Move the test-signal cable from the CH 1 OR X input to the CH 2 OR Y input.

j. Set:

Vertical MODE	CH 2
STORE/NON-STORE	NON-STORE
SAVE/CONTINUE	CONTINUE

Table 5-6
Storage Deflection Accuracy Limits

VOLTS/DIV Switch Setting	Standard Amplitude Signal	Accuracy Limits (Divisions)
5 mV	20 mV	3.88 to 4.12
10 mV	50 mV	4.85 to 5.15
20 mV	0.1 V	4.85 to 5.15
50 mV	0.2 V	3.88 to 4.12
0.1 V	0.5 V	4.85 to 5.15
0.2 V	1 V	4.85 to 5.15
0.5 V	2 V	3.88 to 4.12
1 V	5 V	4.85 to 5.15
2 V	10 V	4.85 to 5.15
5 V	20 V	3.88 to 4.12

k. Repeat parts c through g for CH 2.

l. Disconnect the test equipment from the instrument.

9. Check Store Add Mode

a. Set:

SEC/DIV	0.2 ms
VOLTS/DIV (both)	20 mV
STORE/NON-STORE	NON-STORE
Vertical MODE	BOTH, ADD, NORM

b. Set the calibration generator to output 50 mV and connect it via a dual-input coupler to both CH 1 (X) and CH 2 (Y) inputs.

c. Position the display around the center horizontal graticule line.

d. CHECK—that the displayed signal is between 4.85 and 5.15 divisions in height.

e. Set STORE/NON-STORE to STORE.

f. CHECK—that the displayed signal is between 4.85 and 5.15 divisions in height.

g. Disconnect the test equipment from the instrument.

10. Check Storage Bandwidth

a. Set:

Vertical MODE	CH 1, NORM, ALT
Trigger SOURCE	VERT
VOLTS/DIV (both)	5 mV

b. Connect a 50 kHz signal from the leveled sine-wave generator via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input.

c. CHECK—that the trace has a height of 6 divisions.

NOTE

Near 10 MHz, the waveform display will show extreme amplitude variations. Check the peak-to-peak points of the waveform for the signal amplitude.

d. Increase the signal frequency until a 4.2 division display is obtained.

e. CHECK—that the frequency is greater than 10 MHz.

f. Repeat parts c through e for all VOLTS/DIV settings from 10 mV to 0.5 V.

g. Set Vertical MODE to CH 2.

h. Reduce the signal generator output level to minimum and move the test signal to the CH 2 input.

i. Repeat parts c through e for CH 2 VOLTS/DIV settings from 5 mV to 0.5 V using the CH 2 controls.

11. Check Store Mode Channel Isolation

a. Set:

VOLTS/DIV (CH 1)	1 V
AC-GND-DC (CH 2)	GND
VOLTS/DIV (CH 2)	0.5 V

b. Connect a 50 kHz signal from a leveled sine-wave generator via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input.

c. Set the generator output for a 5-division display amplitude.

d. Increase the generator frequency to 10 MHz.

e. Set:

Vertical MODE	CH 2
VOLTS/DIV (CH 1)	0.5 V

f. CHECK—that the displayed signal is less than 0.1 division in height.

g. Move the test signal to the CH 2 input.

h. Set:

Vertical MODE	CH 1
AC-GND-DC (CH 1)	GND
AC-GND-DC (CH 2)	DC

i. CHECK—that the displayed signal amplitude is less than 0.1 divisions.

j. Disconnect the test equipment from the instrument.

12. Check Common Mode Rejection Ratio

a. Set:

VOLTS/DIV (both)	5 mV
AC-GND-DC (both)	DC

b. Connect a 50 kHz signal from the leveled sine-wave generator via a 50-Ω coaxial cable, a 10X BNC attenuator, a 50-Ω termination and a dual-input coupler to both the CH 1 (X) and CH 2 (Y) inputs.

c. Set the generator to output a 6-division display amplitude.

d. Set Vertical MODE to INV, ADD, BOTH.

e. Increase the signal frequency to 10 MHz.

f. CHECK—that the residual display is less than 0.6 division.

g. Disconnect the test equipment from the instrument.

13. Check Display and Save Ref

a. Set:

Vertical MODE	CH 1
AC-GND-DC (CH 1)	GND
Trigger SOURCE	CH 1
PRE-TRIG	25%

b. ADJUST—the CH 1 Position control so that the trace is on the second from bottom horizontal graticule line.

c. Press SAVE REF.

d. CHECK—that the SAVE REF trace appears and can be positioned more than 3.5 divisions above the reference trace using the Reference Position control.

e. Press the Reference Display ON/OFF button.

f. CHECK—that the SAVE REF trace disappears.

g. Press the Reference Display ON/OFF button.

h. CHECK—that the SAVE REF trace appears and that the Trigger Point (bright dot) is positioned at the same place on both traces.

i. Set the PRE-TRIG button to 75%.

j. CHECK—that the CH 1 display and Trigger Point change but that the REF display remains the same.

k. Press Reference Display ON/OFF to turn off the Reference trace.

14. Check Save/Continue

a. Position the trace on the center horizontal graticule using the CH 1 Position control.

b. Set SAVE/CONTINUE to SAVE.

c. CHECK—that the trace cannot be moved vertically using the Vertical Position control.

d. Set SAVE/CONTINUE to CONTINUE.

e. CHECK—that the trace can be moved using the Vertical Position control.

15. Check Trigger Point

a. Set:

SEC/DIV	50 ms
PRE-TRIG	25%

b. Align the start of the trace with the first vertical graticule line using the Horizontal POSITION controls.

c. CHECK—that the Trigger Point appears towards the beginning of the trace at about 2.6 divisions.

d. Set PRE-TRIG to 75%.

e. CHECK—that the Trigger Point appears towards the end of the trace at about 7.7 divisions.

f. Set SEC/DIV to 0.1 s.

g. CHECK—that the Trigger Point is not present.

h. Set Trigger MODE to SGL SWP.

i. CHECK—that the Trigger Point appears towards the end of the trace at about 7.7 divisions.

j. Set Trigger MODE to P-P AUTO and PRE-TRIG to 25%.

k. Set Trigger MODE to SGL SWP.

l. CHECK—that the Trigger Point appears towards the beginning of the trace at about 2.6 divisions.

16. Check Single Sweep

a. Set:

VOLTS/DIV (CH 1)	0.5 V
AC-GND-DC (CH 1)	DC
SEC/DIV	50 ms
Trigger MODE	NORM

b. Connect 0.1 s time markers from the time-mark generator via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input.

c. ADJUST—the Trigger Level control for stable trigger.

d. Set SEC/DIV to 0.1 s and Trigger MODE to SGL SWP.

e. CHECK—that the display continually scrolls to the left.

f. Press the SGL SWP RESET button.

g. CHECK—that the TRIG'D/READY indicator lights immediately and then goes out. When the indicator has gone out the display should stop scrolling.

h. Press the SGL SWP RESET button.

i. CHECK—that the display clears and both the Trigger indicator and the Trigger Point do not light until the pre-trigger data is acquired.

j. Disconnect the test equipment from the instrument.

17. Check Roll Single Sweep Vert Chop-Alt Trigger

a. Set:

Vertical MODE	BOTH, NORM, ALT
VOLTS/DIV (both)	0.5 V
AC-GND-DC (both)	DC
SEC/DIV	50 ms
Trigger MODE	NORM
Trigger SOURCE	VERT

b. Connect 0.1 s time markers from the time-mark generator via a 50-Ω coaxial cable, a 50-Ω BNC termination and a dual-input coupler to both the CH 1 (X) and the CH 2 (Y) inputs.

c. ADJUST—the Trigger LEVEL control for stable trigger.

d. Position the CH 1 trace to the top portion of the display area and the CH 2 trace to the bottom portion.

e. Set SEC/DIV to 0.1 s and Trigger MODE to SGL SWP.

f. CHECK—that the display continually scrolls to the left.

g. Press SGL SWP RESET.

h. CHECK—that both channels trigger and remain on the screen.

i. CHECK—that every subsequent press of the SGL SWP RESET button updates CH 1 or CH 2 data alternately.

j. Press the SGL SWP RESET button until CH 2 is displayed on the screen.

k. Disconnect the signal from the CH 1 input.

l. Press the SGL SWP RESET button.

m. CHECK—that the display continually scrolls to the left until CH 1 input is reconnected.

n. Disconnect the signal from the CH 2 input.

o. Press the SGL SWP RESET button.

p. CHECK—that the display continually scrolls to the left until CH 2 input is reconnected.

q. Set Vertical MODE to CHOP.

r. Press the SGL SWP RESET button.

s. CHECK—that both channels are displayed and triggered.

t. Disconnect the test equipment from the instrument.

18. Check External Clock Record Mode

a. Set:

Vertical MODE	CH 1, NORM, ALT
SEC/DIV	EXT CLK
Trigger MODE	P-P AUTO
Trigger SOURCE	CH 1

b. Connect a 0-5 V 10 MHz square wave with an equal mark to space ratio from the pulse generator via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the EXT CLK input.

c. Connect 20 μs time markers from the time-mark generator via a 50-Ω BNC coaxial cable and a 50-Ω BNC terminator to the CH 1 OR X input.

d. Set SAVE/CONTINUE to SAVE.

e. CHECK—that the displayed signal has 2 markers per division.

f. Disconnect the test equipment from the instrument.

19. Check External Clock Roll Mode

a. Set:

SAVE/CONTINUE	CONTINUE

b. Turn the Horizontal Variable control fully counterclockwise.

c. Connect a 0-5 V 4 kHz square wave with equal mark-to-space ratio from the pulse generator via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the EXT CLK input.

d. Connect 0.1 s time markers from the time-mark generator via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input.

e. Set SAVE/CONTINUE to SAVE.

f. CHECK—that the displayed signal has 1 marker per division.

g. Return the Horizontal Variable control to its detent position.

h. Disconnect the test equipment from the instrument.

CURSORS AND READOUT

Equipment Required (See Table 4-1):

Time-Mark Generator (Item 3)

50-Ω BNC Coaxial Cable (Item 9)

50-Ω BNC Termination (Item 11)

INITIAL CONTROL SETTINGS

Vertical

POSITION	Midrange
MODE	CH 1, NORM
VOLTS/DIV (both)	5 mV
VOLTS/DIV Variable (both)	CAL detent
Magnification	X1 (CAL knobs in)
AC-GND-DC	DC

Horizontal

POSITION (COARSE and FINE)	Midrange
SEC/DIV	1 ms
SEC/DIV Variable	CAL detent
MAG	X1

Trigger

SLOPE	Positive (⌐)
LEVEL	Midrange
MODE	P-P AUTO
HOLDOFF	MIN
SOURCE	VERT MODE
COUPLING	DC

Storage

STORE/NON-STORE	STORE
PRE-TRIG 25%/75%	75%
ACQ SAVE/CONTINUE	CONTINUE
REFERENCE POSITION	Midrange

Cursors and Readout

ON/OFF	ON
ΔT/1/ΔT	ΔT

PROCEDURE STEPS

1. Check Operation of Readout

a. Set:

Vertical MODE	CH 2, NORM, ADD
VOLTS/DIV (both)	10 mV
SEC/DIV	0.05 μs
Trigger MODE	SGL SWP
Trigger COUPLING	AC
READOUT/STORE INTENSITY	Readout OFF

b. Hold in the ΔV1/ΔV2 and ΔT/1/ΔT push buttons until the Tektronix logo appears on the crt screen.

c. Press the Cursor Position control four times, and check that a diagnostic table appears on the screen.

d. Hold the Cursor Position control in for approximately two seconds until the next menu appears on the crt screen. This menu indicates the last switch/control changed.

e. Set Vertical MODE to BOTH and check that the screen displays VMODE BOTH ADD.

f. Set Vertical MODE to ALT and check that the screen displays VMODE BOTH ALT.

g. Set Vertical MODE to CHOP and check that the screen displays VMODE BOTH CHOP.

h. Set Vertical MODE to CH 1 and check that the screen displays VMODE CH1.

i. Set Vertical MODE to CH 2 and check that the screen displays VMODE CH2.

j. Set Vertical MODE to INV and check that the screen displays VMODE INVERT.

k. Set Vertical MODE to NORM and check that the screen displays VMODE NORM.

l. Set AC-GND-DC (CH 1) to AC and check that the screen displays CH1 CPLNG AC.

m. Set AC-GND-DC (CH 1) to DC and check that the screen displays CH1 CPLNG DC.

n. Set AC-GND-DC (CH 2) to AC and check that the screen displays CH2 CPLNG AC.

o. Set AC-GND-DC (CH 2) to DC and check that the screen displays CH2 CPLNG DC.

p. Set CH 1 Variable to X10 and check that the screen displays CH1 X10.

q. Set CH 1 Variable to X1 and check that the screen displays CH1 X1.

r. Set CH 1 Variable to UNCAL and check that the screen displays CH1 UNCAL.

s. Set CH 1 Variable to CAL and check that the screen displays CH1 CAL.

t. Set CH 2 Variable to X10 and check that the screen displays CH2 X10.

u. Set CH 2 Variable to X1 and check that the screen displays CH2 X1.

v. Set CH 2 Variable to UNCAL and check that the screen displays CH2 UNCAL.

w. Set CH 2 Variable to CAL and check that the screen displays CH2 CAL.

x. Set VOLTS/DIV (CH 1) to 5 mV and check that the screen displays CH1 VOLTS 5mV.

y. Switch the CH 1 VOLTS/DIV control through its various settings checking that the crt screen displays the values shown in Table 5-7.

Table 5-7

VOLTS/DIV Switch Settings/Screen Displays

Switch Setting	Screen Display
10 mV (CH 1/2)	CH 1/2 VOLTS 10 mV
20 mV (CH 1/2)	CH 1/2 VOLTS 20 mV
50 mV (CH 1/2)	CH 1/2 VOLTS 50 mV
0.1 V (CH 1/2)	CH 1/2 VOLTS 0.1 V
0.2 V (CH 1/2)	CH 1/2 VOLTS 0.2 V
0.5 V (CH 1/2)	CH 1/2 VOLTS 0.5 V
1 V (CH 1/2)	CH 1/2 VOLTS 1 V
2 V (CH 1/2)	CH 1/2 VOLTS 2 V
5 V (CH 1/2)	CH 1/2 VOLTS 5 V

z. Repeat items x and y for the CH 2 VOLTS/DIV switch.

aa. Set the Horizontal MAG switch to X10 and check that the screen displays SEC MAG X10.

bb. Set the Horizontal MAG switch to X50 and check that the screen displays SEC MAG X50.

cc. Set the Horizontal MAG switch to X1 and check that the screen displays SEC MAG X1.

dd. Set the SEC/DIV switch to X-Y and check that the screen displays SEC/DIV X-Y.

ee. Switch the SEC/DIV switch through its various settings and check that the screen displays agree with those given in Table 5-8.

ff. Set Trigger MODE, SOURCE and COUPLING to the settings given in Table 5-9 and check that the screen displays agree with those given.

gg. Press the Cursor ON/OFF push button and check that the screen display switches between CURSOR ON and CURSOR OFF.

hh. Press the TRACK/INDEP push button and check that the screen display switches between CURSOR TRACK and CURSOR INDEP.

Table 5-8
SEC/DIV Switch Settings/Screen Displays

SEC/DIV Switch Setting	Screen Display
0.5 s	SEC/DIV 0.5 s
0.2 s	SEC/DIV 0.2 s
0.1 s	SEC/DIV 0.1 s
50 ms	SEC/DIV 50 ms
20 ms	SEC/DIV 20 ms
10 ms	SEC/DIV 10 ms
5 ms	SEC/DIV 5 ms
2 ms	SEC/DIV 2 ms
1 ms	SEC/DIV 1 ms
0.5 ms	SEC/DIV 0.5 ms
0.2 ms	SEC/DIV 0.2 ms
0.1 ms	SEC/DIV 0.1 ms
50 μs	SEC/DIV 50 μs
20 μs	SEC/DIV 20 μs
10 μs	SEC/DIV 10 μs
5 μs	SEC/DIV 5 μs
2 μs	SEC/DIV 2 μs
1 μs	SEC/DIV 1 μs
0.5 μs	SEC/DIV 0.5 μs
0.2 μs	SEC/DIV 0.2 μs
0.1 μs	SEC/DIV 0.1 μs
0.05 μs	SEC/DIV 0.05 μs

ii. Press the STORE/NON-STORE push button and check that the screen display switches between STORE and NON-STORE.

jj. Press the SAVE/CONTINUE push button and check that the screen display switches between ACQ SAVE and ACQ CONTINUE.

kk. Press the Cursor Position control followed by the ΔV1/ΔV2 push button to end the check.

NOTE

The following adjustment may be necessary before adjustment 13, Adjust High-Frequency Compensation, in the Vertical section.

Table 5-9
Trigger MODE, SOURCE and COUPLING Switch Settings/Screen Displays

Switch	Setting	Screen Display	
MODE	P-P AUTO	TRIG MODE	P-P AUTO
MODE	NORM	TRIG MODE	NORM/SGL
MODE	TV FIELD	TRIG MODE	TV-FIELD
MODE	SGL SWP	TRIG MODE	NORM/SGL
SOURCE	CH 1	TRIG SRC	CH 1
SOURCE	VERT	TRIG SRC	VERT
SOURCE	CH 2	TRIG SRC	CH 2
SOURCE	EXT	TRIG SRC	EXT
COUPLING	DC	TRIG CPLNG	DC
COUPLING	HF REJ	TRIG CPLNG	HF-REJ
COUPLING	LF REJ	TRIG CPLNG	LF-REJ
COUPLING	AC	TRIG CPLNG	AC

2. Adjust Readout Jitter (R294)

a. Set:

Vertical MODE	BOTH, NORM, ALT
VOLTS/DIV (both)	5 mV
AC-GND-DC (both)	GND
Horizontal MAG	X1
SEC/DIV	0.2 ms
Trigger MODE	P-P AUTO
Trigger SOURCE	EXT
READOUT	ON

b. Using the POSITION controls, position the CH 1 trace off the top of the crt screen and the CH 2 trace off the bottom.

c. ADJUST—R294 for minimum jitter on the readout display.

3. Adjust X50 Cursor Alignment (R655)

a. Adjust the Cursor Position control to position the cursors on either side of the trigger point.

b. Set the Horizontal MAG to X50.

c. Adjust the Horizontal POSITION control until the cursors and trigger point are visible on the crt screen.

d. ADJUST—R655 until there are no breaks in the cursors.

e. Set PRE-TRIG 25%/75% to 25%.

f. Check that there is no movement in the cursor segments.

4. Check Cursor Accuracy

a. Set STORE/NON-STORE to NON-STORE and press the ΔV1/ΔV2 push button.

b. Position the cursors, using the Cursor Position control, exactly two divisions above and below the center horizontal graticule line.

c. CHECK—that the ΔV1 readout is between 19.80 mV and 20.20 mV.

d. Press the ΔT/1/ΔT push button.

e. Position the cursors, using the Cursor Position control, so that they are aligned with the second and tenth vertical graticule line.

f. CHECK—that the ΔT readout is between 7.92 ms and 8.08 ms.

NOTE

If the instrument fails this check, the DAC CAL must be readjusted.

g. Set:

VOLTS/DIV (CH 1)	0.5 V
STORE/NON-STORE	STORE

h. Connect 1 ms time markers from the time-mark generator via a 50-Ω BNC coaxial cable and a 50-Ω BNC termination to the CH 1 OR X input connector.

i. Position the cursors, using the Cursor Position control, so that they are aligned with the tips of the second and tenth time markers.

j. CHECK—That the ΔT readout is between 7.96 ms and 8.04 ms.

k. Disconnect the test equipment from the instrument.

5. Check Probe Encoding

a. Set:

VOLTS/DIV (both)	0.1 V
VERTICAL MODE	CH 1

b. Read the 0.1 V on the Channel 1 VOLTS/DIV portion of the crt readout.

c. Connect the standard accessory 10X probe to the CH1 OR X connector.

d. CHECK—the Channel 1 VOLTS/DIV portion of the CRT reading charges from 0.1 V to 1 V.

e. Set Vertical MODE to CH 2.

f. Move the X10 probe from the CH 1 OR X input connector to the CH 2 OR Y input connector.

g. CHECK—the Channel 2 VOLTS/DIV portion of the crt readout changes from 0.1V to 1V.

h. Disconnect the X10 probe from the instrument.

MAINTENANCE

This section contains information for conducting preventive maintenance, troubleshooting, and corrective maintenance on the instrument. Circuit board removal procedures are included in the corrective maintenance part of this section.

STATIC-SENSITIVE COMPONENTS

The following precautions are applicable when performing any maintenance involving internal access to the instrument.

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 6-1 lists the relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

When performing maintenance, observe the following precautions to avoid component damage:

1. Minimize handling of static-sensitive components.
2. Transport and store static-sensitive components or assemblies in their original containers or on a metal rail. Label any package that contains static-sensitive components or assemblies.
3. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these components. Servicing static-sensitive components or assemblies 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 their bodies, never by their leads.
7. Do not slide the components over any surface.

Table 6-1
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
Schottky signal diodes	3
Schottky TTL	4
High-frequency bipolar transistors	5
JFET	6
Linear microcircuits	7
Low-power Schottky TTL	8
TTL (Least Sensitive)	9

[a] Voltage equivalent for levels (voltage discharged from a 100-pF capacitor through resistance of 100 Ω):

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

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 approved antistatic, vacuum-type desoldering tools for component removal.

PREVENTIVE MAINTENANCE

INTRODUCTION

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

GENERAL CARE

The cabinet minimizes accumulation of dust inside the instrument and should normally be in place when operating the oscilloscope. The optional front cover for the instrument provides both dust and damage protection for the front panel and crt. A front cover should be fitted whenever the instrument is stored or is being transported.

INSPECTION AND CLEANING

The instrument should be visually inspected and 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. It also provides an electrical conduction path that could result in instrument failure, especially under high-humidity conditions.

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 or a solution of 1% mild detergent with 99% water. Before using any other type of cleaner, consult your Tektronix Service Center or representative.

Exterior

INSPECTION. Inspect the external portions of the instrument for damage, wear, and missing parts; use Table 6-2 as a guide. Instruments that appear to have been dropped or otherwise abused should be checked thoroughly to verify correct operation and performance. Deficiencies found that could cause personal injury or could lead to further damage to the instrument should be repaired immediately.

CAUTION

To prevent getting moisture inside the instrument during external cleaning, use only enough liquid to dampen the cloth or applicator.

CLEANING. Loose dust on the outside of the instrument can be removed with a soft cloth or small soft-bristle brush. The brush is particularly useful for dislodging dirt on and around the controls and connectors. Dirt that remains can be removed with a soft cloth dampened in a mild detergent-and-water solution. Do not use abrasive cleaners.

A plastic light filter is provided with the oscilloscope. Clean the light filter and the crt face with a soft lint-free cloth dampened with either isopropyl alcohol or a mild detergent-and-water solution.

Interior

To gain access to internal portions of the instrument for inspection and cleaning, refer to the "Removal and Replacement Instructions" in the "Corrective Maintenance" part of this section.

INSPECTION. Inspect the internal portions of the instrument for damage and wear, using Table 6-3 as a guide. Deficiencies found should be repaired immediately. The corrective procedure for most visible defects is obvious; however, particular care must be taken if heat-damaged components are found. Overheating usually indicates other trouble in the instrument; therefore, it is important that the cause of overheating be corrected to prevent recurrence of the damage.

If any electrical component is replaced, conduct a Performance Check for the affected circuit and for other closely related circuits (see Section 4). If repair or replacement work is done on any of the power supplies, conduct a complete Performance Check and, if so indicated, an instrument readjustment (see Sections 4 and 5).

Table 6-2
External Inspection Checklist

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

Table 6-3
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.
Resistors	Burned, cracked, broken, or blistered.	Replace defective resistors. Check for cause of burned component and repair as necessary.
Solder Connections	Cold solder or rosin joints.	Resolder joint and clean with isopropyl alcohol.
Capacitors	Damaged or leaking cases. Corroded solder on leads or terminals.	Replace defective capacitors. Clean solder connections and flush with isopropyl alcohol.
Semiconductors	Loosely inserted in sockets. Distorted pins.	Firmly seat loose semiconductors. Remove devices having distorted pins. Carefully straighten pins (as required to fit the socket) using long-nose pliers, and reinsert firmly. Ensure that straightening action does not crack pins, causing them to break.
Wiring and Cables	Burned, broken, or frayed wiring.	Firmly seat connectors. Repair or replace defective wires or cables.
Chassis	Dents, deformations, and damaged hardware.	Straighten, repair, or replace defective hardware.

CAUTION

To prevent damage from electrical arcing, ensure that circuit boards and components are dry before applying power to the instrument.

CLEANING. To clean the interior, blow off dust with dry, low-pressure air (approximately 9 psi). Remove any remaining dust with a soft brush or a cloth dampened with a solution of mild detergent and water. A cotton-tipped applicator is useful for cleaning in narrow spaces and on circuit boards.

VOLT/DIV and SEC/DIV SWITCHES. These are maintenance free. DO NOT CLEAN.

CAUTION

Most spray-type circuit coolants contain Freon 12 as a propellant. Because many Freons adversely affect switch contacts, do not use spray-type coolants on the switches or attenuators. Carbon based solvents will damage the board material.

LUBRICATION

Most of the potentiometers used in this instrument are permanently sealed and generally do not require periodic lubrication. All switches, both rotary- and lever-type, are installed with proper lubrication applied where necessary and will rarely require any additional lubrication. A regular periodic lubrication program for the instrument is therefore, not recommended.

SEMICONDUCTOR CHECKS

Periodic checks of the transistors and other semiconductors in the oscilloscope are not recommended. The best check of semiconductor performance is actual operation in the instrument.

PERIODIC READJUSTMENT

To ensure accurate measurements, check the performance of this instrument every 2000 hours of operation, or if used infrequently, once each year. In addition, replacement of components may necessitate readjustment of the affected circuits.

Complete Performance Check and Adjustment instructions are given in Sections 4 and 5. The Performance Check Procedure can also be helpful in localizing certain troubles in the instrument. In some cases, minor problems may be revealed or corrected by readjustment. If only a partial adjustment is performed, see the interaction chart, Table 5-1, for possible adjustment interaction with other circuits.

TROUBLESHOOTING

INTRODUCTION

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 material presented in the "Theory of Operation" and "Diagrams" sections of this manual may be helpful while troubleshooting.

TROUBLESHOOTING AIDS

Schematic Diagrams

Complete schematic diagrams are located on tabbed foldout pages in the "Diagrams" section. Portions of circuitry mounted on each circuit board are enclosed by dotted lines. The assembly number and name of the circuit are shown near either the top or the bottom edge of the enclosed area.

Functional blocks on schematic diagrams are outlined with another dotted line. Components within the outlined area perform the function designated by the block label. The "Theory of Operation" uses these functional block names when describing circuit operation as an aid in cross-referencing between the theory and the schematic diagrams.

Component numbers and electrical values of components in this instrument are shown on the schematic diagrams. Refer to the first page of the "Diagrams" section for the reference designators and symbols used to identify components. Important voltages and waveform reference numbers (enclosed in hexagonal-shaped boxes) are also shown on each diagram. Waveform illustrations are located adjacent to their respective schematic diagram.

Circuit Board Illustrations

Circuit board illustrations showing the physical location of each component are provided for use in conjunction with each schematic diagram. Each board illustration is found in the "Diagrams" section on the back of a foldout page, preceding the first schematic diagram(s) to which it relates.

The locations of waveform test points are marked on the circuit board illustrations with hexagonal outlined numbers corresponding to the waveform numbers on both the schematic diagram and the waveform illustrations.

Also provided in the "Diagrams" section is an illustration of the bottom side of the Main circuit board. This illustration aids in troubleshooting by showing the connection pads for the components mounted on the top side of the circuit board. By using this illustration, circuit tracing and probing for voltages and signals that are inaccessible from the top side of the board may be achieved without dismantling portions of the instrument.

Circuit Board Locations

The placement of each circuit board in the instrument is shown in board locator illustrations. These illustrations are located on foldout pages along with the circuit board illustration.

Circuit Board Interconnections

A circuit board interconnection diagram is provided in the "Diagrams" section to aid in tracing a signal path or power source between boards. All wire, plug, and jack numbers are shown along with their associated wire or pin numbers.

Power Distribution

A Power Distribution diagram is provided to aid in troubleshooting power supply problems. This diagram shows the service jumper connections used to apply power to the various circuit boards. Excessive loading on a power supply by a circuit board fault may be isolated by disconnecting the appropriate service jumpers.

Grid Coordinate System

Each schematic diagram and circuit board illustration has a grid border along its left and top edges. A table located adjacent to each diagram lists the grid coordinates of each component shown on that diagram. To aid in physically locating components on the circuit board, this table also lists the grid coordinates of each component on the circuit board illustration.

Near each circuit board illustration is an alphanumeric listing of all components mounted on that board. The second column in each listing identifies the schematic diagram in which each component can be found. These component-locator tables are especially useful when more than one schematic diagram is associated with a particular circuit board.

Component Color Coding

Information regarding color codes and markings of resistors and capacitors is located on the color-coding illustration (Figure 9-1) at the beginning of the "Diagrams" section.

RESISTOR COLOR CODE. Resistors used in this instrument are carbon-film, composition, or precision metal-film types. They are usually color coded with the EIA color code; however, some metal-film type resistors may have the value printed on the body. The color code is interpreted starting with the stripe nearest to one end of the resistor. Composition resistors have four stripes; these represent two significant digits, a multiplier, and a tolerance value. Metal-film resistors have five stripes representing three significant digits, a multiplier, and a tolerance value.

CAPACITOR MARKINGS. Capacitance values of common disc capacitors and small electrolytics are marked on the side of the capacitor body. White ceramic capacitors are color coded in picofarads, using a modified EIA code.

Dipped tantalum capacitors are color coded in microfarads. The color dot indicates both the positive lead and the voltage rating. Since these capacitors are easily destroyed by reversed or excessive voltage, be careful to observe the polarity and voltage rating when replacing them.

DIODE COLOR CODE. The cathode end of each glass-encased diode is indicated by either a stripe, a series of stripes or a dot. For most diodes marked with a series of stripes, the color combination of the stripes identifies three digits of the Tektronix Part Number, using the resistor color-code system. The cathode and anode ends of a metal-encased diode may be identified by the diode symbol marked on its body.

Semiconductor Lead Configurations

Figure 9-2 in the "Diagrams" section shows the lead configurations for semiconductor devices used in the instrument. These lead configurations and case styles are typical of those used at completion of the instrument design. Vendor changes and performance improvement changes may result in changes of case styles or lead configurations. If the device in question does not appear to match the configuration shown in Figure 9-2, examine the associated circuitry or consult the manufacturer's data sheet.

RIBBON-CABLE CONNECTORS

The multipin connectors of the 2211 are designed to make the interboard connections directly to the ribbon cables. Insert the trimmed ribbon-cable wires into the connector slots (see Figure 6-1). Pressing down on the release bar (the top of the connector) with your fingertip will make it easier to push the wires into the connector. The cable locks firmly into the connector when the pressure is removed from the release bar. To disconnect the ribbon cable from the connector, press down on the release bar and lift the cable out of the connector. The ribbon cable wire should be evenly trimmed to expose 5 mm of wire (about 1/4 inch) for correct insertion into the connectors.

The ribbon cables are either color coded in the standard color codes or have a striped index wire. Align the index wire with the pin 1 indicator when reinserting a cable into its connector, unless the original cable was inserted the other way round.

NOTE

Special attention should be taken when removing cables. Some cables may not follow the standard indexing and actually be installed in reverse.

Storage Board Cables

If the Storage Board is raised for servicing, two of the ribbon cables to the board must be replaced with longer cables in order to operate the oscilloscope correctly. Connect the replacement ribbon cables between J1001-A and J1002-A (on the Main Board) and J1001 and J1002 (on the Storage Board).

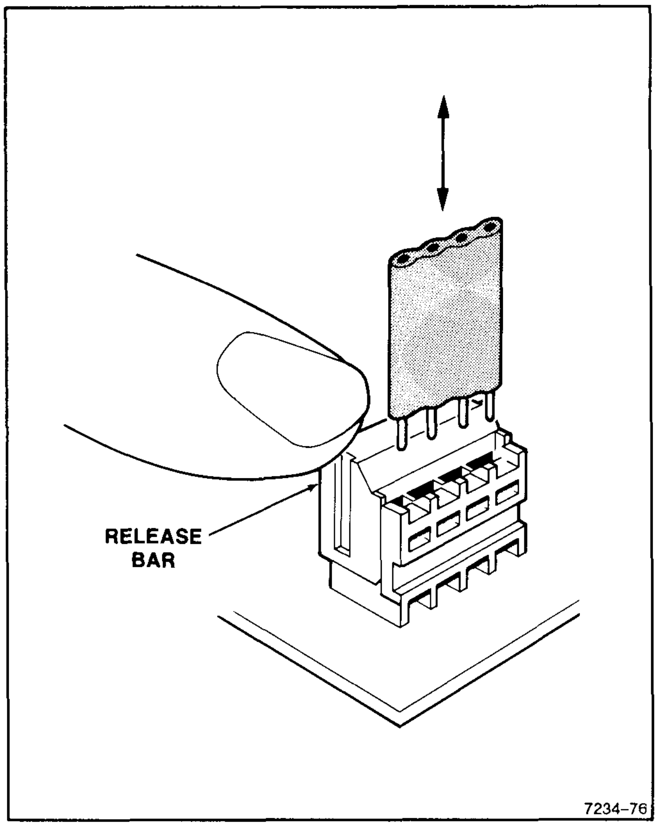


Figure 6-1. Multi-connector operation.

TROUBLESHOOTING EQUIPMENT

The equipment listed in Table 4-1 of this manual, or equivalent equipment, may be useful when troubleshooting this instrument.

TROUBLESHOOTING TECHNIQUES

The following procedure is arranged in an order that enables checking simple trouble possibilities before requiring more extensive troubleshooting. The first four steps ensure proper control settings, connections, operation, and adjustment. If the trouble is not located by these checks, the remaining steps will 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.

CAUTION

Before using any test equipment to make measurements on static-sensitive, current-sensitive, or voltage-sensitive components or assemblies, ensure that any voltage or current supplied by the test equipment does not exceed the limits of the component to be tested.

1. Check Control Settings

Incorrect control settings can give a false indication of instrument malfunction. If there is any question about the correct function or operation of any control, refer to either the "Operating Information" in Section 2 of this manual or to the Operators Manual.

2. Check Associated Equipment

Before proceeding, ensure that any equipment used with the instrument is operating correctly. Verify that input signals are properly connected and that the interconnecting cables are not defective. Check that the ac-power-source voltage to all equipment is correct.

WARNING

To avoid electrical shock, disconnect the instrument from the ac power source before making a visual inspection of the internal circuitry.

3. Visual Check

Perform a visual inspection. This check may reveal broken connections or wires, damaged components, semiconductors not firmly mounted, damaged circuit boards, or other clues to the cause of an instrument malfunction.

WARNING

Dangerous potentials exist at several points throughout this instrument. If it is operated with the cabinet removed, do not touch exposed connections or components.

4. Check Instrument Performance and Adjustment

Check the performance of either those circuits where trouble appears to exist or the entire instrument. The apparent trouble may be the result of misadjustment.

Complete performance check and adjustment instructions are given in Sections 4 and 5 of this manual.

5. Isolate Trouble to a Circuit

To isolate problems to a particular area, use any symptoms noticed to help locate the trouble.

6. Check Power Supplies

WARNING

For safety reasons, an isolation transformer must be connected whenever troubleshooting is done in the Preregulator and Inverter Power Supply sections of the instrument.

When trouble symptoms appear in more that one circuit, first check the power supplies; then check the affected circuits by taking voltage and waveform readings. Check first for the correct output voltage of each individual supply. These voltages are measured between the power supply test points and ground (see the associated circuit board illustration and Table 6-4).

Voltage levels may be measured either with a DMM or with an oscilloscope. Voltage ripple amplitudes must be measured using an oscilloscope. Before checking power-supply circuitry, set the INTENSITY control to normal brightness, the SEC/DIV switch to 0.1 ms, the TRIGGER Mode to P-P AUTO, and set the VERTICAL MODE switch to CH 1.

When measuring ripple, use a 1X probe. The ripple values listed are based on a system limited in bandwidth to 30 kHz. Using a system with wider bandwidth will result in higher readings.

If the power-supply voltages and ripple are within the ranges listed in Table 6-4, the supply can be assumed to be working correctly. If they are outside the range, the supply may be either misadjusted or operating incorrectly. Use the "Power Supply and CRT Display" subsection in the "Adjustment" procedure to adjust the -8.6 V supply.

A defective component elsewhere in the instrument can create the appearance of a power-supply problem and may also affect the operation of other circuits.

7. Check Circuit Board Interconnections

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

8. Check Voltages and Waveforms

Often the defective component can be located by checking circuit voltages or waveforms. Typical voltages are listed on the schematic diagrams. Waveforms indicated on the schematic diagrams by hexagonal-outlined numbers are shown adjacent to the diagrams. Waveform test points are shown on the circuit board illustrations.

NOTE

Voltages and waveforms indicated on the schematic diagrams are not absolute and may vary slightly between instruments. To establish operating conditions similar to those used to obtain these readings, see the "Voltage and Waveform Setup Conditions" preceding the waveform illustrations in the "Diagrams" section. Note the recommended test equipment, front-panel control settings, voltage and waveform conditions, and cable-connection instructions. Any special control settings required to obtain a given waveform are noted under the waveform illustration.

Table 6-4
Power Supply Voltage and Ripple Limits

Power Supply	Test Point	Reading (Volts)	P-P Ripple (mV)
-8.6 V	W989	-8.557 to -8.643	30 mV
-5.2 V	W993	-5.356 to -5.044	20 mV
+5.1 V	W991	+4.947 to 5.253	20 mV
+5.1 VD	W995	+4.947 to 5.253	20 mV
+8.7 V	W987	+8.526 to 8.874	39 mV
+38 V	W972	+36.86 to 39.14	30 mV
+99 V	W984	+96.03 to 101.97	175 mV

Changes to the control settings from the initial setup, other than those noted, are not required.

9. Check Individual Components

WARNING

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

The following procedures describe methods of checking individual components. Two-lead components that are soldered in place are most accurately checked by first disconnecting one end from the circuit board. This isolates the measurement from the effects of the surrounding circuitry. See Figure 9-1 for component value identification and Figure 9-2 for semiconductor lead configurations.

CAUTION

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

TRANSISTORS. A good check of a transistor is actual performance under operating conditions. A transistor can most effectively be checked by substituting a known-good component. However, be sure that circuit conditions are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use a dynamic-type transistor checker for testing. Static-type transistor checkers are not recommended, since they do not check operation under simulated operating conditions.

When troubleshooting transistors in the circuit with a voltmeter, measure both the emitter-to-base and emitter-to-collector voltages to determine whether they are consistent with normal circuit voltages. Voltages across a transistor may vary with the type of device and its circuit function.

Some of these voltages are predictable. The emitter-to-base voltage for a conducting silicon transistor will normally range from 0.6 V to 0.8 V. The emitter-to-collector voltage for a saturated transistor is about 0.2 V. Because these values are small, the best way to check them is by connecting a sensitive voltmeter across the junction rather that comparing two voltages taken with respect to ground. If the former method is used, both leads of the voltmeter must be isolated from ground.

If voltage values measured are less that those just given, either the device is shorted or no current is flowing in the external circuit. If values exceed the emitter-to-base values given, either the junction is reverse biased or the device is defective. Voltages exceeding those given for typical emitter-to-collector values could indicate either a nonsaturated device operating normally or a defective (open-circuited) transistor. If the device is conducting, voltage will be developed across the resistors in series with it; if open, no voltage will be developed across the resistors unless current is being supplied by a parallel path.

CAUTION

When checking emitter-to-base junctions, do not use an ohmmeter range that has a high internal current. High current may damage the transistor. Reverse biasing the emitter-to-base junction with a high current may degrade the current-transfer ratio (Beta) of the transistor.

A transistor emitter-to-base junction also can be checked for an open or shorted condition by measuring the resistance between terminals with an ohmmeter set to a range having a low internal source current, such as the R X 1 kΩ range. The junction resistance should be very high in one direction and much lower when the meter leads are reversed.

When troubleshooting a field-effect transistor (FET), the voltage across its elements can be checked in the same manner as previously described for other transistors. However, remember that in the normal depletion mode of operation, the gate-to-source junction is reverse biased; in the enhanced mode, the junction is forward biased.

INTEGRATED CIRCUITS. An integrated circuit (IC) can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of circuit operation is essential when troubleshooting a circuit having IC components. Use care when checking voltages and waveforms around the IC so that adjacent leads are not shorted together. An IC test clip provides a convenient means of clipping a test probe to an IC.

CAUTION

When checking a diode, do not use an ohmmeter scale that has a high internal current. High current may damage a diode. Checks on diodes can be performed in much the same manner as those on transistor emitter-to-base junctions. Do not check tunnel diodes or back diodes with an ohmmeter; use a dynamic tester, such as the TEKTRONIX 576 Curve Tracer.

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

Silicon diodes should have 0.6 V to 0.8 V across their junctions when conducting; Schottky diodes about 0.2 V to 0.4 V. Higher readings indicate that they are either reverse biased or defective, depending on polarity.

RESISTORS. Check resistors with an ohmmeter. Refer to the "Replaceable Electrical Parts" list for the tolerances of resistors used in this instrument. A resistor normally does not require replacement unless its measured value varies widely from its specified value and tolerance.

INDUCTORS. 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 set to one of the highest ranges. Do not exceed the voltage rating of the capacitor. The resistance reading should be high after the capacitor is charged to the output voltage of the ohmmeter. An open capacitor can be detected with a capacitance meter or by checking whether the capacitor passes ac signals.

10. Repair and Adjust the Circuit

If any defective parts are located, follow the replacement procedures given under "Corrective Maintenance" in this section. After any electrical component has been replaced, the performance of that circuit and any other closely related circuit should be checked. Since the power supplies affect all circuits, performance of the entire instrument should be checked if work has been done on the power supplies or if the power transformer has been replaced. Readjustment of the affected circuitry may be necessary. Refer to the "Performance Check" and "Adjustment Procedure, " Sections 4 and 5 of this manual and to Table 5-1 (Adjustment affected by repairs).

POWER SUPPLY TROUBLESHOOTING

The Power Supply is divided into four blocks: Power Input, Pre-regulator, Series Regulator, and the Inverter. Troubleshooting of the Power Supply is easier when a problem can be isolated to a particular block. First, a little information on each of the blocks will give you some insight into what each is and does in the Power Supply. Refer to the Power Supply schematic (diagram 11) to follow this discussion.

Introduction

POWER INPUT. This circuitry is on the A4 (Mains Input) board. It consists of the toroidal mains transformer (T901), the Line Selector Switch (S902), the mains rectifier (CR901, CR902, CR903 and CR904), and the filter capacitor (C900). The line EMI filter, power fuse, and the line sync pickoff circuit are also on the A4 circuit board. The functions of the Mains Input circuitry are:

Filter mains transients from the input power lines (L901, L902, C903, and C904),

Protect the oscilloscope from excessive current (F901),

Select the correct windings for the applied mains voltage (S902),

Convert the mains voltage to a lower voltage level (T901), and

Rectify and filter the output of T901.

PREREGULATOR. The Preregulator stabilizes the +38 V supply to the inverter over a wide variation of the mains input voltage level. This is done by U910 sensing the +38 V supply and adjusting the duty cycle of the square wave drive to Q911, Q912 and Q913. The conduction time of Q913 is varied to compensate for changes in either the supply voltage or normal loading by the oscilloscope circuitry. The output pulses from Q913 are filtered by L910 and C914.

SERIES REGULATOR. The Series Regulator has two purposes:

Reject any ripple on the +38 V supply at twice the line frequency and regulate the -8.6 V supply.

Both functions are done by altering the conduction level of Q923, thereby altering the +38 V supply voltage level to ground. Ripple on the +38 V supply line is rejected by monitoring a portion of the voltage and comparing it with a reference supply from VR931 and changing the conduction of Q923 to eliminate common-mode variations.

Regulation of the -8.6 V supply is maintained via U920A by varying the reference on U920B slightly to alter the +38 V supply.

INVERTER. The Inverter drives the inverter transformer from the +38 V supply. Drive to the transformer is obtained from switching transistors Q950 and Q980. The complementary output of U940 is amplified by Q930 and Q940, and Q960 and Q970 to drive the bases of the switching transistors. The outputs of the inverter transformer windings are full-wave rectified and filtered to provide the supply voltages to the oscilloscope circuitry.

Troubleshooting

CAUTION

Use an isolation transformer for safety when troubleshooting in the primary circuitry of the power supply (see Table 6-5).

CHECK FOR LOADING. Use this procedure to isolate the problem to the Power Supply or the remainder of the oscilloscope circuitry.

1. Measure the resistance of the low voltage power supplies (see Table 6-5).
2. If the load resistances are correct, check the Power Input block.
3. If one or more of the power supplies have low resistance to ground, troubleshoot the oscilloscope for loading. Use the following steps to isolate the excessive load. The more difficult and least useful steps appear at the end of the procedure.

Table 6-5
Power Supply Resistance to Ground

Supply	Test Point	Approximate Resistance
-8.6 V	TP989	60 Ω
-5.2 V	TP993	500 Ω
+5.1 V	TP991	100 Ω
+5.1 VD	W995	100 Ω
+8.6 V	TP987	80 Ω
+38 V	TP972	1.1 kΩ
+100 V	TP984	3 kΩ

a. Disconnect W1006 at J1006 to remove the +5.1 V and -5.2 V supplies from the Storage board.

b. Disconnect W90 at J90 to remove the +38 V, +8.6 V, -8.6 V and +5.1 V supplies from the Attenuator/Timebase board (A2).

c. Disconnect W1001, W1002 and W1008 from their respective wire trap connectors to remove the +8.6 V and -8.6 V supplies from the Storage board.

d. Disconnect W3 at J3 to remove the -8.6 V and +8.6 V supplies from the Front-Panel board (A3).

e. Disconnect W1301 at J1301 to remove the +5.1 VD supply from the Cursor-Readout board (A11).

f. Disconnect W1306 at J1306 to remove the +8.6 V and -8.6 V supplies to the Cursor-Readout board (A11).

g. Disconnect W1304 at J1304-A on the Attenuator/Timebase board (A2) to remove the +8.6 V supply from the Storage board.

h Disconnect W1302 at J1302-B on the Storage board to remove the +5.1 VD supply from the Storage board.

i Disconnect W1307 at J1307 on the Cursor-Readout board to remove the +5.1 VD supply from the Cursor Pot board (A6).

j. Lift the individual jumpers (W971, W972, W984, W985, W987, W989, W991, W993 or W995) to isolate an indicated excessive load on a supply line to the Main board.

k. Disconnect the H.V. lead to the high voltage multiplier (U975) from T902 to isolate the multiplier from the Power Supply.

l. Disconnect the crt anode lead and crt base socket to isolate the crt from the Power Supply.

CHECK POWER INPUT BLOCK. The power supply will operate with an ac input voltage of 95 V to 128 V on the 115 V range and 185 V to 250 V on the 230 V range.

1. If the fuse is blowing, isolate the Power input from the Main board by disconnecting W903 at the Main board. If the fuse does not blow, go to step 2.

2. Check the output voltage at pins 1 and 2 of W903 for approximately 61 Vdc.

3. If the Power Input section is ok, check the +38 V supply.

4. If the output voltage from the Power Input section is not correct, troubleshoot the Power Input circuitry.

NOTE

The connector for J902 is not polarized, and the power supply will function normally with the plug reversed.

CHECK +38 V SUPPLY. The +38 V supply is regulated by the Preregulator.

1. Check for approximately +38 V at TP972 and at L910.

2. If the +38 V supply is not correct, check the Preregulator.

3. If the +38 V supply is within specification, check the Inverter.

CHECK PREREGULATOR. The preregulator stabilizes the +38 V supply and keeps the supply level constant over the operating range of the mains input voltage.

1. Check for 60 Vdc across C915.

2. Check for +38.5 to 39 V at TP972 with the -8.6 V supply set to the correct voltage at TP989.

NOTE

The +38 V supply will vary a little with respect to chassis ground as R833 (-8.6 V SET) is adjusted to the correct level.

3. Check that the voltage across the current limit resistor (R907) is approximately 243 mV. If it is more than 300 mV, U910 will detect excess current being drawn and limit the +38 V supply accordingly.

4. Check that as the ac input voltage amplitude is varied (using a variac to supply the input to the oscilloscope from the mains supply), the duty cycle of the waveform on the collector of Q913 adjusts. The duty cycle must change to keep the +38 V output constant over the operating voltage range.

5. Check the following components if the Preregulator does not function.

   a. Q913 and Q912 for shorts.

   b. R920 for open. It can fail if Q912 shorts.

   c. VR910 for correct voltage limiting (27 V).

   d. U910 nonoperational.

   e. L910 for a short to the core.

6. If the Preregulator is ok, check the Series Regulator.

CHECK SERIES REGULATOR. The Series Regulator is a series pass circuit with two functions: it rejects ripple on the +38 V supply line, and regulates the -8.6 V supply. Isolate a problem in the Series Regulator with the following steps.

1. Check the voltage across Q923. It should be approximately 1.1 V. The value will vary slightly with the efficiency of the inverter transformer and other components in the circuit.

2. If the voltage across Q923 is near 2 V, or has reached a maximum of 5.5 V, then there is an overload on one of the supply voltages.

3. Check the following components:

   a. Q923 for short.

   b. Q921 for quality (excess reverse current).

   c. U920 nonoperational.

   d. VR931 for high voltage (should be 6.2 V zener).

   e. VR942 for short.

4. If the supply voltages are low, and you suspect that the Series Regulator is at fault, there is a test that may be used to confirm the remainder of the Power Supply circuitry. You will need a variac to supply the mains voltage to the oscilloscope.

CAUTION

This test should be done for short periods of time only.

   a. Switch the oscilloscope off and set the variac to zero output.

   b. Connect a jumper across Q923 from collector to emitter.

c. Turn on the oscilloscope and slowly increase the variac output voltage while monitoring the +38 V supply.

d. The +38 V supply should rise to about 41 V and the -8.6 V supply should be about -9.2 V.

e. Switch the oscilloscope off as soon as you determine whether or not the supply voltages are coming up.

If the voltages rise correctly, the remainder of the circuitry is correct. If the +38 V supply rises to +41 V, but the -8.6 V supply stays low, then there is also a fault in the Inverter section.

If the +38 V supply does not come up, there is a problem elsewhere in the Power Supply circuitry.

CHECK INVERTER. The Inverter drives the inverter transformer from the +38 V supply. Use the following check to troubleshoot the Inverter.

1. Check that the +38 V supply is +38.5 to 39.0 V.

2. Check that there is a +3 V to +75 V square wave drive signal at the emitters of Q950 and Q980.

3. If the +38 V supply exceeds 42 V, the Inverter will be shut down.

4. Remove the secondary loads from the inverter transformer (see the CHECK FOR LOADING procedure given previously).

   a. If the +38 V supply is high and the secondaries are low, then the efficiency of the Inverter is probably low. Only one side of the drive circuit is operating or the inverter transformer may be bad.

   b. If the +38 V supply is about +27 V, and the Power Supply is in current limit, monitor the waveform at the emitters of Q950 and Q980. If a square wave signal is not present, suspect that T902 has developed an internal short circuit between adjacent turns.

5. Check the following components for failure:

   a T902 for faults.

   b. Q950 and Q980 for shorts. If either has failed, check the respective drive transistor.

   c. U940 not operating.

   d. VR942 for short.

   e. C952 and C982 for short and R953 and R983 for open.

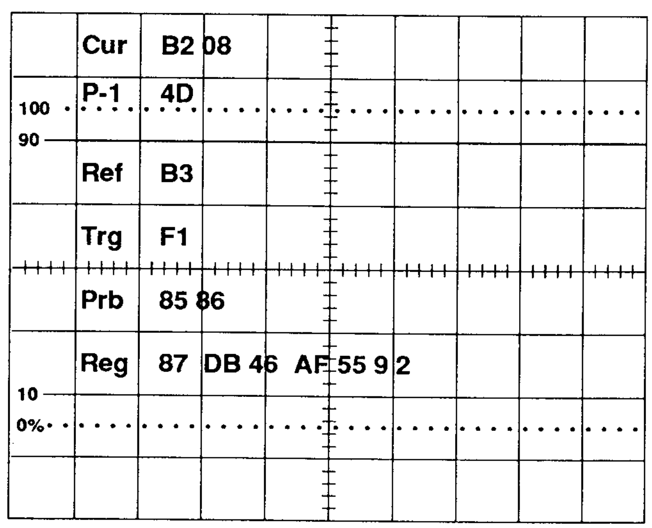
REPLACEMENT OF INVERTER TRANSFORMER. The inverter transformer will only fit into the circuit board in one direction. There are three brown flying leads from the transformer. The two leads close together are the crt heater supply leads; the one by itself is the H.V. supply lead.

READOUT SYSTEM DIAGNOSTIC AID

The 2211 can assist faultfinding of the readout system by displaying the data that is decoded to produce the readout fields.

An example of the CRT display is shown in Figure 6-2.

This display can be enabled by pushing the CURSORS ΔV1/ΔV2 and ΔT/1/ΔT buttons at the same time for about five seconds, then depressing the CURSORS rotary control repeatedly until this display arrives.



7234-81

Figure 6-2. Example of CRT display.

The information in each of the display fields depends on the front panel settings of the 2211. The display shown corresponds to the following front panel control setting:

CURSORS
- INDEP
- ON

ACQ
- SAVE
- 75%

STORE
- On

VERTICAL MODE
- CH 1
- NORM
- CHOP

CH1 VOLTS/DIV
- 2 V
- CAL
- X10
  - Off

CH 2 VOLTS/DIV
- 2 V
- CAL
- X10
  - Off

Input Coupling
- CH 1
  - DC
- CH 2
  - DC

SEC/DIV
- 20 μs
- CAL
- MAG
  - X1

TRIGGER
- MODE
  - P-P AUTO
- SOURCE
  - VERT MODE
  - LINE
- COUPLING
  - DC

STORE/READOUT
- INTENSITY near midscale

P6109 X10 encoded probes on CH 1 and CH 2 inputs.

The data displayed can also depend on the history of control operations since the instrument was switched on. The display of Figure 6-2 assumes that the instrument has been switched on (no control operations before diagnostic page selection).

The data values displayed next to the Cur, Ref and Trg labels are dependent on the rotation of the CURSORS control, the VERTICAL REF POS control and the TRIGGER LEVEL control respectively, so may be different from the display example. The data values displayed next to the Prb label depend on the tolerance of resistor values. Limits for these display values are defined in Table 6-6.

Table 6-6
Probe Coding Values

CODING OF PROBE	DIAGNOSTIC CODE (lower to upper)
Ident	0 to 5D
X100	5E to 79
Ident	7A to 7B
X10	7C to 93
X1	94 to FF

Analog Voltage Displays

The voltages on the wipers of the CURSORS control are fed to the cursor/readout board (A11) by cable W1307. The two halves of U1350 are unity gain voltage followers that act as impedance buffers for these signals. The outputs are connected to two of the eight inputs to the Analog to Digital converter U1341.

The voltage on the wiper of the VERTICAL REF POS control is connected via cable W1306 to the input of unity gain amplifier U1344A. The output is connected to an input of the A to D converter U1341.

A differential signal proportional to the trigger level setting is passed to the amplifier U1344B. The output is connected to an input of the A to D converter U1341.

The resistors in the P6109 probe encoding form part of resistive potential dividers. The outputs of these dividers connect via cable W1306 to two of the inputs of the A to D converter U1341.

The software executed by the cursor/readout microprocessor (CPU) U1302 will periodically call for conversion results from the A to D converter U1341. A CPU cycle with Hexadecimal address in the range 0900 to 09FF will assert memory map decode CRMAP0_1(L). This will define channel selection (from the 3 least significant address bits) and initiate the conversion cycle. The signal CONV_CPLT goes LO to indicate that a conversion is in progress, then HI to indicate that it is complete. This signal is tested by the CPU.

A CPU read cycle with Hexadecimal address in the range 0A00 to 0AFF will assert memory map decode CPMAP0_1(L). This will read the conversion result from the A to D converter into the CPU.

The conversion results for each of the five inputs that are used on U1341 are converted from eight binary bits to two Hexadecimal digits for display on the CRT readout.

Serial Shift Register Display

The data values displayed next to the Reg label are dependent on the positions of certain front panel switches. The switches are connected to the parallel load inputs of a shift register chain that is distributed on the main board (A1), attenuator/timebase board (A2) and the cursor/readout board (A11). This shift register chain is shown on diagram 13.

The shift register chain terminates at U1342 on diagram 41. The shift register chain loads data in parallel from the front panel settings when the CPU address decode CRMAP0_4(L) is LO. The shift register chain shifts data one bit towards U1342 when address decode CRMAP0_5(L) is LO. U1342 drives its stored data onto the CPU data bus when CRMAP0_0(L) is LO. A parallel load is followed by repeated sequence of shifts and read operations under control of the fixed program executed by processor (CPU) U1302. This allows the CPU to read all logic levels present on all shift register parallel load inputs.

The program executed by the CPU translates the data read from the shift register chain into Hexadecimal digits for display on the CRT.

Controls Affecting Shift Register Display

Table 6-7 is a matrix, showing how the characters displayed on the CRT screen relate to the front panel controls and the (internal) components of the circuit.

NOTE

The STORE/READOUT INTENSITY control can be seen to affect the display if it is rotated counterclockwise for a few seconds then clockwise. The display can be seen to update after about one second.

This table will help to identify defective shift registers or interconnections. Each character in the column heading can be traced down to the control or circuit reference row which it is affected by, indicated with "■".

For assistance in diagnosing front panel switch defects refer to the section titled "EXERCISE SWITCHES" DIAGNOSTIC AID.

Cursor/Readout Processor Port

The data value displayed next to the P-1 label is a Hexadecimal representation of the inputs to the cursor/readout processor (CPU) U1302 Port 1.

Some of the signals on CPU port 1 (pins 8 and 13..20) are inputs to the CPU and some are outputs from the CPU.

The program executed by the CPU translates the bit pattern on Port 1 into two Hexadecimal digits for display on the CRT.

Serial Interface Plot/Print Response

The serial interface board (A21) responds to the operator pressing the PRINT/PLOT button on the side cup by asserting the signal RTC_AVAIL HI connected from the serial interface CPU U1246 to the cursor/readout interface CPU U1302 by cable W1305.

In normal operation this signal starts the transfer of status information from the cursor/readout system to the serial interface circuits. See the Theory of Operation section for a detailed description of the data transfer.

The integrity of the signal path to the cursor/readout processor can be verified without removing the instrument case.

With the diagnostic page of Figure 6-2 displayed, the P-1 display should read 4D. Momentarily depressing the PLOT/PRINT button on the side cup should change the display to 6D. This confirms that the serial interface CPU has responded to the side cupPLOT/PRINT button and that the signal RTC_AVAIL is properly connected to the cursor/readout processor.

Exercise Switches

The next 'page' of the diagnostic aid can help to identify defective switches. When the diagnostic aid shown in Figure 6-2 is displayed, the CURSORS rotary control can be depressed for about five seconds to activate the next diagnostic aid.

Table 6-7
Controls Affecting Shift Register Display

Reg	8	7	D	B	4	6	A	E	5	5	9	2
Front Panel Controls												
CURSOR												
push rotary	■											
push buttons		■										
SAVE				■								
STORE				■								
VERTICAL												
CH 1 AC			■									
CH 2 AC				■								
CH 1/BOTH/CH 2			■									
ADD/ALT/CHOP			■									
NORM/CH 2 INVERT												■
CH 1 VOLTS/DIV										■		
CH 1 PULL X10												■
CH 1 CAL												■
CH 2 VOLTS/DIV									■			
CH 2 PULL X10												■
CH 2 CAL											■	
SEC/DIV												
SEC/DIV							■	■				
CAL											■	
MAG											■	
TRIGGER												
MODE					■	■						
SOURCE					■	■						
COUPLING					■	■						
STORE/READOUT INTENSITY					■							
Internal Components												
CIRCUIT REFERENCE												
A11 U1345	■	■										
A1 U1408			■	■								
A1 U1406					■	■						
A2 U1404							■	■				
A2 U1402									■	■		
A2 U1400											■	■

The message **EXERCISE SWITCHES COMMENCE TEST** prompts the operator to change switch settings. Not all switch positions are visible to the diagnostic aid.

These control positions can be checked:

CURSORS

- ΔV1/ΔV2
- ΔT /1/ΔT
- TRACK/INDEP
- ON/OFF

ACQ

- SAVE/CONTINUE

STORE/NON-STORE

VERTICAL

- MODE
  - CH 1/BOTH/CH 2
  - NORM/CH 2 INVERT
  - ADD/ALT/CHOP*
- CH 1 VOLTS/DIV
  - CH 1 PULL X10
  - CH 1 CAL
  - CH 1 coupling AC **
- CH 2 VOLTS/DIV
  - CH 2 PULL X10
  - CH 2 CAL
- CH 2 coupling AC **

SEC/DIV

- SEC/DIV
- CAL
- MAG
  - X1/X10/X50

TRIGGER

- MODE
  - P-P AUTO/NORM/TV FIELD ***
- SOURCE
  - CH 1/VERT MODE/CH 2/EXT
- COUPLING
  - AC/LF REJ/HF REJ/DC

STORE/READOUT INTENSITY

*** This switch can only be checked with VERTICAL MODE BOTH selected.**

**** AC is the only switch position detected, not DC or GND.**

***** SGL SWP position is not detected for this switch, the display will read NORM.**

CORRECTIVE MAINTENANCE

INTRODUCTION

Corrective maintenance consists of component replacement and instrument repair. This part of the manual describes special techniques and procedures required to replace components in this instrument. If it is necessary to ship your instrument to a Tektronix Service Center for repair or service, refer to the "Repackaging" information in Section 2 of this manual.

MAINTENANCE PRECAUTIONS

To reduce the possibility of personal injury or instrument damage, observe the following precautions.

1. Disconnect the instrument from the ac-power source before removing or installing components.
2. Verify that the line-rectifier filter capacitors and the power reservoir capacitor, C900, are discharged prior to performing any servicing.
3. Use care not to interconnect instrument grounds which may be at different potentials (cross grounding).
4. When soldering on circuit boards or small insulated wires, use only a 15-watt, pencil-type soldering iron.

OBTAINING REPLACEMENT PARTS

Most electrical and mechanical parts can be obtained through your local Tektronix Field Office or representative. However, many of the standard electronic components can usually be obtained from a local commercial source. Before purchasing or ordering 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

Physical size and shape of a component may affect instrument performance, particularly at high frequencies. Always use direct-replacement components, unless it is known that a substitute will not degrade instrument performance.

Special Parts

In addition to the standard electronic components, some special parts are used in the instrument. These components are manufactured or selected by Tektronix, Inc. to meet specific performance requirements, or are manufactured for Tektronix, Inc. in accordance with our specifications. The various manufacturers can be identified by referring to the "Cross Index-Manufacturer's Code number to Manufacturer" at the beginning of the "Replaceable Electrical Parts" list. Most of the mechanical parts used in this instrument were manufactured by Tektronix, Inc. Order all special parts directly from your local Tektronix Field Office or representative.

Ordering Parts

When ordering replacement parts from Tektronix, Inc., be sure to include all of the following information:

1. Instrument type (include all modification and option numbers).
2. Instrument serial number.
3. A description of the part (if electrical, include its full circuit component number).
4. Tektronix part number.

Selectable Components

Several components in the instrument are selectable to obtain optimum circuit operation. Value selection of these components is done during the initial factory adjustment procedure. Usually, further selection is not necessary for subsequent adjustments unless a component has been changed that affects circuitry for which a selected component has been specifically chosen.

MAINTENANCE AIDS

The maintenance aids listed in Table 6-8 include items required for performing most of the maintenance procedures in this instrument. Equivalent products may be substituted for those given, provided their characteristics are similar.

Table 6-8
Maintenance Aids

Description	Specification	Usage	Example
1. Soldering Iron	15 to 25 W.	General soldering and unsoldering.	Antex Precision Model C.
2. Torx Screwdriver	Torx tips #T9, #T10, #T15 and #T20	Assembly and disassembly.	Tektronix p/n #T9 003-0965-00, #T10 003-0814-00, #T15 003-0966-00, #T20 003-0866-00.
3. Nutdrivers	1/4 inch, 7/16 inch.	Assembly and disassembly.	Xcelite #8, #14 and #16.
4. Open-end Wrench	5/16 inch and 7/16 1/2 inch.	Channel Input, EXT BNC connectors, and transformer removal.	Tektronix p/n 1/2 inch 003-0882-00.
5. Hex Wrenches	1/16 inch.	Assembly and disassembly.	Allen wrenches.
6. Long-nose Pliers		Component removal and replacement.	
7. Diagonal Cutters		Component removal and replacement.	
8. Vacuum Solder Extractor	No Static Charge Retention.	Unsoldering components.	Pace Model PC-10.
9. 1X Probe		Power supply ripple check.	Tektronix P6101 Probe (X1), p/n 010-6101-03.
10. Isolation Transformer		Safety isolation for power supply trouble-shooting.	Tektronix p/n 006-5953-00.

INTERCONNECTIONS

Interconnections in this instrument are made with wire-traps soldered onto the circuit boards. If any individual wire in the cable is faulty, the entire cable assembly should be replaced. To remove a cable from a wire trap, press down on top of the wire trap and lift out cable. Reinstallation is the reverse of this procedure. To provide correct orientation of a cable, a number "1" is stamped on the circuit board. The cable is either color-coded, so the index is the brown wire, or the index wire is striped a different color to the rest of the cable. Be sure these index wires are aligned with the "1" when the cable is reinstalled (see Figure 6-1).

NOTE

Special attention should be taken when removing cables. Some cables may not follow the standard indexing and actually be installed in reverse.

TRANSISTORS AND INTEGRATED CIRCUITS

Transistors and integrated circuits should not be replaced unless they are actually defective. If removed from their sockets or unsoldered from the circuit board during routine maintenance, return them to their original board locations. Unnecessary replacement or transposing of semiconductor devices may affect the adjustment of the instrument. When a semiconductor is replaced, check the performance of any circuit that may be affected.

Any replacement component should be of the original type or a direct replacement. Bend transistor leads to fit their circuit board holes, and cut the leads to the same length as the original component. See Figure 9-2 in the "Diagrams" section for lead-configuration illustrations.

The chassis-mounted power supply transistor Q913 is insulated from the chassis by a heat-transferring pad and insulation bush. Reinstall the pad and bush when replacing this transistor.

NOTE

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

To remove socketed dual-in-line packaged (DIP) integrated circuits, pull slowly and evenly on both ends of the device. Avoid disengaging one end of the integrated circuit from the socket before the other, since this may damage the pins.

To remove a soldered DIP IC when it is going to be replaced, clip all the leads of the device and remove the leads from the circuit board one at a time. If the device must be removed intact for possible reinstallation, do not heat adjacent conductors consecutively. Apply heat to pins at alternate sides and ends of the IC as solder is removed. Allow a moment for the circuit board to cool before proceeding to the next pin.

SOLDERING TECHNIQUES

The reliability and accuracy of this instrument can be maintained only if proper soldering techniques are used to remove or replace parts. General soldering techniques, which apply to maintenance of any precision electronic equipment, should be used when working on this instrument.

WARNING

To avoid an electric-shock hazard, observe the following precautions before attempting any soldering: turn the instrument off, disconnect it from the ac power source, and wait at least three minutes for the line-rectifier filter capacitors to discharge.

Use rosin-core wire solder containing 63% tin and 37% lead. Contact your local Tektronix Field Office or representative to obtain the names of approved solder types.

When soldering on circuits boards or small insulated wires, use only a 15-watt, pencil-type soldering iron. A higher wattage soldering iron may cause etched circuit conductors to separate from the board base material and melt the insulation on small wires. Always keep the soldering-iron tip properly tinned to ensure best heat transfer from the iron tip to the solder joint. Apply only enough solder to make a firm joint. After soldering, clean the area around the solder connection with an approved flux-removing solvent (such as isopropyl alcohol) and allow it to air dry.

CAUTION

Attempts to unsolder, remove, and resolder leads from the component side of a circuit board may cause damage to the reverse side of the circuit board. The following techniques should be used to replace a component on a circuit board:

1. Touch the vacuum desoldering tool to the lead at the solder connection. Never place the iron directly on the board; doing so may damage the board.

NOTE

Some components are difficult to remove from the circuit board due to a bend placed in the component leads during machine insertion. To make removal of machine-inserted components easier, straighten the component leads on the reverse side of the circuit board.

2. When removing a multipin component, especially an IC, do not heat adjacent pins consecutively. Apply heat to the pins at alternate sides and ends of the IC as solder is removed. Allow a moment for the circuit board to cool before proceeding to the next pin.

CAUTION

Excessive heat can cause the etched circuit conductors to separate from the circuit board. Never allow the solder extractor tip to remain at one place on the board for more than three seconds. Damage caused by poor soldering techniques can void the instrument warranty.

3. Bend the leads of the replacement component to fit the holes in the circuit board. If the component is replaced while the board is installed in the instrument, cut the leads so they protrude only a small amount through the reverse side of the circuit board. Excess lead length may cause shorting to other conductive parts.

4. Insert the leads into the holes of the board so that the replacement component is positioned the same as the original component. Most components should be firmly seated against the circuit board.

5. Touch the soldering iron to the connection and apply enough solder to make a firm solder joint. Do not move the component while the solder hardens.

6. Cut off any excess lead protruding through the circuit board (if not clipped to the correct length in step 3).

7. Clean the area around the solder connection with an approved flux-removing solvent. Be careful not to remove any of the printed information from the circuit board.

REMOVAL AND REPLACEMENT INSTRUCTIONS

The exploded view drawings in the "Replaceable Mechanical Parts" list (Section 10) may be helpful during the removal and reinstallation of individual subassemblies or components. Circuit board and component locations are shown in the "Diagrams" section.

Cabinet

WARNING

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

To remove the instrument cabinet, perform the following steps:

1. Disconnect the power cord from the instrument. For instruments with a power-cord securing clamp, remove the screw holding the power-cord securing clamp before disconnecting the power cord.

2. Remove two screws from the rear panel (located on each side) and remove it from the instrument.

3. Remove the five ground springs fitted between the chassis and the cabinet (instructions for reinstallation are contained in the notice positioned on the inside of the rear cover).

4. Remove two screws, one from the left-rear side and one from the right-rear side of the cabinet.

5. Push the instrument forward in the cabinet and disengage the cabinet locating lug from the top rear center of the chassis.

6. Pull the front panel and attached chassis forward and out of the cabinet.

7. To reinstall the cabinet, perform the reverse of the preceding steps. Ensure that the cabinet is flush with the rear of the chassis and that the cabinet and rear-panel holes are aligned with the screw holes in the chassis frame. Ensure that the five ground springs are refitted at the correct locations.

8. Reconnect the power cord.

Storage Board Assembly

The storage board assembly can be removed and reinstalled as follows:

1. Remove the cabinet as described in the section entitled "Cabinet".

2. Remove the 'cup' around the EXT CLOCK connector by removing the screw just below the connector.

3. Remove five screws holding the storage board assembly to the chassis, noting the position and locations of the ground springs. See Figure 6-3.

4. Remove the front shield mounting screw and ground spring.

5. Remove the two countersunk screws located on the upper right chassis member.

6. Remove the five storage and four cursor switch push buttons by gently easing them off via a small flat-blade screwdriver placed between the switch and the push button.

7. Raise the left edge of the board assembly and disconnect the two ribbon cables from the cable traps. See Figure 6-1 for details on how to release the cables.

NOTE

The board assembly is now free from the chassis but is still connected to the main board, attenuator board and cursor pot board by cables running along the back edge of the storage board and shield.

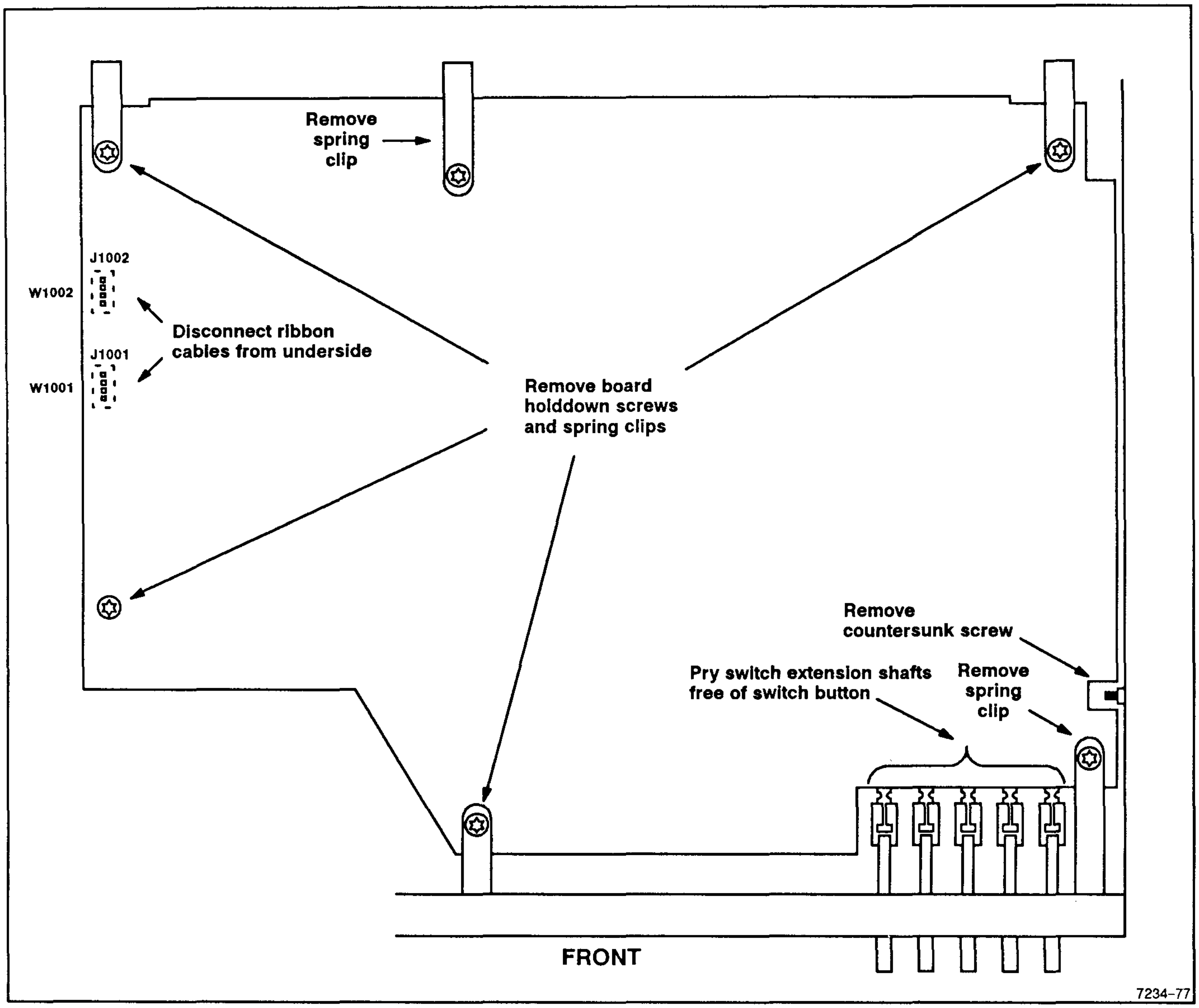


Figure 6-3. Storage board removal.

8. Lift the front of the board assembly, being careful not to strain the cables still attached to the boards, until they are vertical. Place the storage board in the locating slots of the rear fixing brackets.

9. To reinstall the storage board assembly reverse the above procedure, being careful to check the orientation of the cables.

NOTE

When fitting the fixing screws, fit the long screw in between the shield assemblies hinges first.

A10 Storage Board

1. Remove the cabinet as described in the section entitled "Cabinet".

2. Remove the Storage board assembly as described in the section entitled "Storage Board Assembly".

3. Unsolder the resistor link between the EXT CLOCK BNC and the Storage board.

4. Remove the remaining screw that holds the shield assembly to the Storage Board and hinge open the shield assembly; disconnect the ribbon cables between the shield assembly and the storage board.

5. While holding the shield assembly, use a pair of pliers to squeeze the sides of the plastic pegs which protrude through the track side of the storage board (this releases the hinges), and push them through the board. Lower the shield assembly back into the instrument.

6. The storage board can now be completely removed by disconnecting the ribbon cables along the back edge of the board.

7. To reinstall the storage board reverse the above procedure, being careful to check the orientation of the cables.

A11 Cursor-Readout Board

1. Remove the cabinet as described in the section entitled "Cabinet".

2. Remove the Storage board assembly as described in the section entitled "Storage Board Assembly".

3. Remove the three mounting screws and hinge out the Cursor-Readout board from the shield assembly.

4. Disconnect the ribbon cables between the Cursor-Readout board and the shield assembly.

5. While holding the shield assembly, use a pair of pliers to squeeze the sides of the plastic pegs which protrude through the component side of the Cursor-Readout board (this releases the hinges), and push them through the board.

6. The Cursor-Readout board is now fully released.

7. To reinstall the Cursor-Readout board reverse the above procedure, being careful to check the orientation of the cables.

A21 Serial Interface

1. Remove the cabinet as described in the section entitled "Cabinet".

2. Remove the Storage board assembly as described in the section entitled "Storage Board Assembly".

3. Remove the Cursor-Readout board as described in the section entitled "Cursor-Readout Board".

4. Remove the three Cursor-Readout board support spacers.

5. Remove the interface mounting bracket by first removing the nut and screw which fix the serial interface board to the shield and interface mounting bracket, then removing the EXT CLOCK BNC, the two SERIAL PORT connector mounting screws, and the ground spring and screw.

6. Remove the remaining three fixing nuts, lift the Cursor-Readout board hinges so that the board mounting faces are perpendicular to the serial interface board, and then lift the serial interface board out of the shield.

7. To reinstall the Serial Interface Board reverse the above procedure.

Cathode-Ray Tube

WARNING

Use care when handling a crt. Breakage of the crt may cause high-velocity scattering of glass fragments (implosion). Protective clothing and safety glasses should be worn. Avoid striking the crt on any object which may cause it to crack or implode. When storing a crt, either place it in a protective carton or set it face down on a smooth surface in a protected location with a soft mat under the faceplate.

The crt can be removed and reinstalled as follows:

1. Remove the cabinet as described in the section entitled "Cabinet".

2. Remove the Storage board assembly as described in the section entitled "Storage Board Assembly".

3. Unsolder the Trace Rotation wires (J987) from the Front-Panel circuit board (note the connection locations and wire colors for reinstallation reference).

WARNING

The crt anode lead retains a high-voltage charge after the instrument is turned off. To avoid electrical shock, disconnect the crt anode lead from the multiplier and ground the lead to the main instrument chassis. Take care that the anode lead is kept away from the cables and components on the Storage Board assembly until it is discharged.

4. Remove the crt anode lead retaining clip from the Attenuator/Timebase board, unplug the crt anode lead connector from the High-Voltage Multiplier which protrudes through the inner chassis. Discharge the anode lead connector to chassis ground.

5. Remove two front-panel screws that retain the plastic crt frame and light filter to the front panel. Remove the crt frame and light filter from the instrument.

6. Remove the grounding spring from between the top of the crt funnel and front chassis.

7. Remove the crt socket cap from the rear of the crt socket. Save the cap for reinstallation.

8. With the rear of the instrument facing you, place the fingers of both hands over the front edge of the front subpanel. Then, using both thumbs, press forward gently on the crt funnel near the front of the crt. When the crt base pins disengage from the socket, remove the crt and the crt shield through the instrument front panel. Place the crt in a safe place until it is reinstalled. If the plastic crt corner pads fall out, save them for reinstallation.

NOTE

When installing the crt into the instrument, reinstall any loose plastic crt corner pads that are out of place. Ensure all crt pins are straight and that the indexing keys on the crt base, socket, and shield are aligned. Ensure that the ground clip makes contact only with the outside of the crt shield.

9. To reinstall the crt, perform the reverse of the preceding steps.

Power Transformer

The Power Transformer (T901) can be removed and reinstalled as follows:

1. Remove the cabinet as described in the section entitled "Cabinet".

2. Remove the black plastic protection cover located between the rear and inner chassis members, by arching the cover upwards until the front locating lugs are free. Then pull the cover forward until the rear lugs are free from rear chassis.

3. Disconnect connector J902 from the Line Filter board, (J902 is not polarized and can be fitted either way). Note the orientation of the Power Transformer.

4. Supporting the transformer, remove the central mounting bolt (complete with the rear stiffening plate).

5. To reinstall the Power Transformer, perform the reverse of the preceding steps.

Fan Assembly

The Fan Assembly can be removed and reinstalled as follows:

1. Remove the cabinet as described in the section entitled "Cabinet".

2. Remove the Power Transformer as described in the section entitled "Power Transformer".

3. Turn the instrument over (Main Board up) and unsolder the two Fan wires from the main board, taking care to note their correct location.

4. Unsolder the four power transistors from the board, Q913, Q923, Q950, Q980.

5. Remove the two screws holding the Fan Assembly to the Main Board.

6. Turn the instrument over and remove the screw holding the Fan Assembly to the top chassis member.

7. The Fan Assembly can then be removed from the instrument.

8. The Fan or the power transistors can now be unbolted from the Fan/heatsink bracket as required.

9. To reinstall the Fan Assembly, perform the reverse of the preceding steps.

Line Filter Circuit Board

WARNING

The screw and nut which secure the Line Filter board to the inner chassis provide safety electrical grounding and must be properly replaced.

The Line Filter circuit board can be removed and reinstalled as follows:

1. Remove the cabinet as described in the section entitled "Cabinet".
2. Remove the black plastic protection cover located between the rear and inner chassis members, by arching the cover upwards until the front locating lugs are free. Then pull the cover forward until the rear lugs are free from rear chassis.
3. Disconnect connector J902 from the Line Filter board. (J902 is not polarized so can be fitted either way).
4. Unsolder W903 from Line Filter board.
5. Disengage the Power switch extension shaft from the Mains Power switch (S901).
6. Remove the two screws and nuts that secure the AC Power inlet connector to the rear chassis.
7. Remove the Main Earth screw and nut that secures the Line Filter board to the inner chassis.
8. Pull the Line Filter board towards the inner chassis and up out of the instrument.
9. To reinstall the Line Filter board, perform the reverse of the preceding steps.

A2-Attenuator/Timebase Circuit Board

The Attenuator/Timebase circuit board can be removed and reinstalled as follows:

1. Remove the cabinet as described in the section entitled "Cabinet".
2. Turn the instrument over (Main circuit board up) and unsolder the two resistors from the CH 1 and CH 2 attenuator switches. Also desolder the earthing straps connected between the Front Panel and the Attenuator/Timebase board, noting their respective positions. Remove the screw that secures the Front Panel brace pillar to the Attenuator/Timebase board. Turn the instrument over again and continue with the Attenuator/Timebase circuit board procedure.
3. Remove the Storage board assembly as described in the section entitled "Storage Board Assembly".
4. Use a 1/16-inch hex wrench to loosen the set screws on both the CH 1 and CH 2 VOLTS/DIV Variable knobs, and SEC/DIV Variable knob. Remove the knobs. Withdraw the CH 1 and CH 2 VOLTS/DIV knobs and SEC/DIV knob.
5. Remove the two rear screws that secure the Attenuator/Timebase board to the support pillars.
6. Remove both screws that secure the Front Panel brace to the Attenuator/Timebase board and front chassis. Remove both the front panel brace and pillar.
7. Remove the Focus knob shaft by disengaging from the Focus pot and pulling the shaft from out of the front panel.

WARNING

The crt anode lead retains a high-voltage charge after the instrument is turned off. To avoid electrical shock, disconnect the crt anode lead from the multiplier and ground the lead to the main instrument chassis. Take care that the anode lead is kept away from the cables and components on the Storage Board assembly until it is discharged.

8. Unplug the crt anode lead connector from the High-Voltage Multiplier which protrudes through the inner chassis. Discharge the anode lead connector to chassis ground.
9. Disconnect the following cables from the Attenuator/Timebase circuit board, noting their locations for reinstallation reference:
   a. J7, a six-wire cable located between the CH 2 attenuator switch and the SEC/DIV switch.
   b. J30, a four-wire cable located to the left of the CH 1 attenuator switch.
   c. J80, a four-wire cable located between the CH 1 and CH 2 attenuator switches.
   d. J90, a six-wire cable located at the rear edge of the board.
   e. J701, a six-wire cable located at the front right-hand corner of the board.
   f. J1010, a four-wire cable located at the rear edge of the board.
   g. J1304, a four-wire cable located at the rear right-hand corner of the board.

h. J1400, a four-wire cable located at the rear left-hand corner of the board.

10. Pull the Attenuator/Timebase circuit board straight back from the front of the instrument until the attenuator switches are clear of the Front-Panel circuit board. Then lift out the entire assembly through the top of the instrument.

11. To reinstall the Attenuator/Timebase circuit board, perform the reverse of the preceding steps, being careful to check the orientation of the cables.

The Bottom Shield of the Attenuator/Timebase circuit board assembly can be removed by; first removing the grounding screw, then the two fixing screws and nuts, all located at the front edge of the board.

A3-Front-Panel Circuit Board

The Front-Panel circuit board can be removed and reinstalled as follows:

1. Remove the cabinet as described in the section entitled "Cabinet".

2. Remove the Attenuator/Timebase board as described in the section entitled "Attenuator/ Timebase Board".

3. Remove the knobs from the following control shafts by pulling them straight out from the front panel:

   a. Channel 1 and Channel 2 POSITION.

   b. REFERENCE POSITION.

   c. COARSE and FINE Horizontal POSITION controls.

   d. LEVEL.

   e. HOLDOFF.

4. Unsolder both the resistor to the EXT INPUT center connector and the wire strap to the EXT INPUT ground lug.

5. Unsolder the resistors and wire straps to the CH 1 OR X and CH 2 OR Y input connectors.

6. Unsolder the Trace Rotation wires (J987) from the Front-Panel circuit board (note the connection locations and wire colors for reinstallation reference).

7. Remove the Power Switch extension shaft by disengaging from power switch and pulling through from Front Panel.

8 Disconnect the following cables from the Front Panel board to the front edge of the Main circuit board: J1, J2, J3, J4, J5 and J6.

9. Remove the five screws that secure the Front Panel board to the front chassis, noting their respective positions.

10. Withdraw the Front Panel circuit board from the front chassis, taking care not to lose the slider switch covers.

11. To reinstall the Front-Panel circuit board, perform the reverse of the preceding steps.

Cursor Potentiometer Assembly

The cursor potentiometer assembly can be removed and reinstalled as follows:

1. Remove the cabinet as described in the section entitled "Cabinet".

2. Raise and open the Storage board assembly as described in the section entitled "Storage Board".

3. Disconnect the ribbon cable J1307 from the rear left-hand corner of the cursors and readout board.

4. Using a 1/16-inch hex wrench, loosen the set screw on the cursors knob and remove it.

5. Remove the potentiometer fixing nut and washer; the potentiometer may now be withdrawn from the instrument. A note of the run of the ribbon cable should be made for reinstallation.

6. To reinstall the cursor potentiometer assembly, perform the reverse of the preceding steps.

NOTE

When refitting the cursor knob, ensure that there is sufficient clearance between the knob and the fixing nut to allow the cursor toggle (this is a push-switch built into the potentiometer) to function correctly.

Intensity Potentiometer Assembly

1. Remove the cabinet as described in the section entitled "Cabinet".

2. Raise the Storage board assembly as described in the section entitled "Storage Board Assembly".

3. Disconnect the ribbon cable J800 from the left-hand side of the main board, in front of the chassis inner and beside the crt.

4. Using a 1/16-inch hex wrench, loosen the set screws on both the inner and outer intensity knobs and remove them.

5. Remove the potentiometer fixing nut and washer; the potentiometer may now be withdrawn from the instrument. A note of the run of the ribbon cable should be made for reinstallation.

6. To reinstall the intensity potentiometer assembly, perform the reverse of the preceding steps.

NOTE

When refitting the intensity knobs, ensure that there is sufficient clearance between the inner and outer knobs to allow their independent action.

A1 Main Circuit Board

Once the Storage board is removed, all components on the Main circuit board are accessible either directly or by removing either the crt, Power Transformer, Fan or the Attenuator/Timebase circuit board assembly. Removal of the Main circuit board is required only when it is necessary to replace the circuit board with a new one.

The Main circuit board can be removed and reinstalled as follows:

WARNING

The crt anode lead and the output terminal to the High-Voltage Multiplier will retain a high-voltage charge after the instrument is turned off. To avoid electrical shock, ground the crt side of the anode lead to the main instrument chassis.

1. Remove the crt as described in the section entitled "Cathode-Ray Tube".

2. Remove the fan assembly as described in the section entitled "Fan Assembly".

3. Unsolder from the Main board the cable (W983), that is connected to the Focus pot located on the rear of the inner chassis.

4. Unsolder the cable (W903) from the rear of the Line Filter board.

5. Disengage the following cables from their respective wire traps located on the Attenuator/Timebase board:

   a. J30, four-wire cable located at the left hand side of the CH 1 attenuator switch.

   b. J80, four-wire cable located between the CH 1 and CH 2 attenuator switches.

   c. J90, six-wire cable located at center rear edge of board.

   d. J701, six-wire cable located at front right corner of board.

   e. J1400, four-wire cable located at rear right corner of board.

6. Turn instrument upside down (bottom of Main board facing up) with the rear of the instrument facing you.

7. Remove the two screws that secure the heatsink for the vertical output transistors (Q256 and Q257) to the rear chassis.

8. Unsolder both ends of the Delay Line (DL224) from the Main board, noting correct polarization for refitting. Remove the two cable clips from Main board.

9. With the instrument still upside down, rotate it so that the front is facing you. Unsolder from the Main board the wires connected to the Probe Adjust pin (W590), CH 1 BNC (W100) and CH 2 BNC (W151).

10. Remove the following cables from their respective wire traps located along the front edge of the Main board — J1, J2, J3, J4, J5 and J6.

11. Remove the two screws that secure the inner chassis to center of the Main board.

12. Remove the three screws that secure the Main board to the pillars of the Attenuator/Timebase assembly.

13. Remove the two screws and nuts that secure the Main board to the left-hand chassis member.

14. Remove the three screws and nuts that secure the Main board to the right-hand chassis member.

15. Lift out Main board from chassis, carefully withdrawing the Multiplier connector through the hole in the inner chassis.

To reinstall the Main circuit board, perform the reverse of the preceding steps. When installing the Main circuit board, ensure that the circuit board is in the guides at the rear of the chassis.

OPTIONS

INTRODUCTION

This part contains a general description of instrument options available at the time of publication of this manual. Also included is a complete list (with Tektronix part numbers) of standard accessories included with each instrument and a partial list of optional accessories. Additional information about instrument options, option availability, and other accessories can be obtained either by consulting the current Tektronix Product Catalog or by contacting your local Tektronix Field Office or representative.

INTERNATIONAL POWER CORD

Instruments are shipped with the detachable power-cord configuration ordered by the customer. Information about the international power-cord options is provided in Section 2, Preparation for Use. Table 7-1 identifies the Tektronix part number for the available power cords.

Standard	North American 120 V, 60 Hz, 74 in.
Option A1	Universal Euro 220V, 50 Hz, 2.5 m
Option A2	UK 240 V, 50 Hz, 2.5 m
Option A3	Australian 240 V, 50 Hz, 2.5 m
Option A4	North American 220 V, 50 Hz, 2.5 m
Option A5	Switzerland 220 V, 50 Hz, 2.5 m

OPTION 1R RACKMOUNTED INSTRUMENT

When the oscilloscope is ordered with Option 1R, it is shipped in a configuration that permits easy installation into virtually any 19-inch-wide, electronic-equipment rack. All hardware is supplied for mounting the instrument into the rack.

Complete rackmounting instructions are provided in a separate document. These instructions also contain the procedures for converting a standard instrument into the Option 1R configuration by using the separately ordered rack-mounting conversion kit.

OPTION 02

This option is intended for users who need added front-panel protection and accessories-carrying ease demanded by frequent travel to remote service sites. It includes a protective front-panel cover and an accessories pouch that attaches to the top of the instrument.

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

When ordering parts, 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 Mfg. Code Number to Manufacturer Cross 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 parts list)

Example a. component number

A23R1234 — A23 (Assembly number) R1234 (Circuit number)

Read: Resistor 1234 of Assembly 23

Example b. component number

A23A2R1234 — A23 (Assembly number) A2 (Subassembly number) R1234 (Circuit number)

Read: Resistor 1234 of Subassembly 2 of Assembly 23

The circuit component's number appears 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 parts list)

Indicates part number to be used when ordering replacement part from Tektronix.

SERIAL NO. (columns three and four of the 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 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 Catalog handbook H6-1 can be utilized where possible.

MFR. CODE (column six of the 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 NO. (column seven of the parts list)

Indicates actual manufacturer's part number.

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
D5243	ROEDERSTEIN E SPEZIALFABRIK FUER KONDENSATOREN GMBN	LUDMILLASTRASSE 23-25	8300 LANDSHUT GERMANY
K0491	SEALECTRO LTD	WALTON ROAD FARLINGTON	PORTSMOUNT ENGLAND
K1439	STEALITE RODERSTEIN LTD HAGLEY HOUSE	EDGBASTON	BIRMINGHAM 16 ENGLAND
K3176	ORMISTON P AND SONS LTD	BROUGHTON RD	LONDON W13 8RW ENGLAND
K5545	AVEL LINDBERG LTD AVELEY INDUSTRIAL EST.	ARCANY ROAD SOUTH OCKENDON	ESSEX ENGLAND
K5856	RCA LTD BEECH HOUSE	373-399 LONDON ROAD CAMBERLEY	SURREY ENGLAND
K7068	SILICONIX LTD	MORRISTON	SWANSEA WALES
K7779	SIEMENS LTD SIEMENS HOUSE	WINDMILL ROAD SUNBURY-ON-THAMES	MIDDLESEX TW16 7HS ENGLAND
K8788	PIHER INTERNATIONAL LTD	HORTON ROAD WEST DRAYTON	MIDDLESEX ENGLAND
K8996	MULLARD LIMITED	MULLARD HOUSE TORRINGTON PLACE	LONDON WC1E 7HD ENGLAND
S0319	MITSUBISHI ELECTRIC CORP	2-2-3 MARUNOUCHI CHIYODA-KU	TOKYO JAPAN
S5085	SHIN-EL TUSHIN KOGYO CO LTD EXPORT DEPT 24-12	TOYOTAMANAKA 3 CHOME NERIMA-KU	TOKYO JAPAN
TK0DY	A F BULGIN & CO LTD	BYE PASS ROAD BARKING	ESSEX ENGLAND
TK0DZ	ACROTRONICS	WOOD BURCOTE TRADING EST.	TOWCESTER ENGLAND
TK0EA	ARMON ELECTRONICS HERON HOUSE	109 WEMBLY HILL ROAD WEMBLY	MIDDX ENGLAND
TK0ED	COMPONENTS BUREAU UNIT 4	135 DITTON WAY	CAMBRIDGE ENGLAND
TK0EF	FERRANTI ELECTRONICS	FILEDS NEW ROAD SHADDERTON - OLDHAM	LANCS ENGLAND
TK0EM	MOLEX ELECTRONICS MOLEX HOUSE	FARNHAM ROAD BORDON	HAMPSHIRE ENGLAND
TK0EN	MOTOROLA SEMICONDUCTORS FAIRFAX HOUSE	69 BUCKINGHAM STREET AYLESBURY	BUCKS ENGLAND
TK0FX	KESTRONICS	POTTERS BAR	HERTS RKL9S 102JW ENGLAND
TK0GA	CYPRESS SEMICONDUCTOR CORP PRONTO ELECTRONIC SYSTEMS LTD	GANTS HILL	ESSEX ENGLAND
TK0GB	NEC	LINFORD WOOD	MILTON KEYNES ENGLAND
TK0GW	ROEDERSTEIN		HOLLAND
TK00A	G ENGLISH ELECTRONICS LTD	34 BOWATER ROAD	LONDON SE18 5TF ENGLAND
TK0213	TOPTRON CORP		TOKYO JAPAN
TK0515	EVOX-RIFA INC	100 TRI-STATE INTERNATIONAL SUITE 290	LINCOLNSHIRE IL 60015
TK0891	MICONICS	1 FAIRCHILD AVE	PLAINVIEW NY 11803
TK0900	UNITED CHEMI-CON INC	9801 W HIGGINS SUITE 430	ROSEMONT IL 60018-4704

CROSS INDEX – MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
TK1016	TOSHIBA AMERICA INC ELECTRONIC COMPONENTS DIV BUSINESS SECTOR	2692 DOW AVE	TUSTIN CA 92680
TK1360	DALE ELECTRONICS INC	462 LIONEL DR	EL PASO TX 79935
TK1424	MARCON AMERICA CORP	3 PEARL CT	ALLENDALE NJ 07401
TK1442	TAIYO–YUDEN (USA) INC	ARLINGTON CENTER 714 W ALGONQUIN RD	ARLINGTON HEIGHTS IL 60005
TK1544	COMPUTER CONNECTIONS	30608 SAN ANTONIO ST	HAYWARD CA 94544
TK1725	GREENPAR CONNECTORS LTD	PO BOX 15 HARLOW	ESSEX CM20 2ER ENGLAND
TK1727	PHILIPS NEDERLAND BV AFD ELONCO	POSTBUS 90050	5600 PB EINDHOVEN THE NETHERLANDS
TK1743	UNITRODE (UK) LTD	6 CRESSWELL PARK BLACKHEATH	LONDON SE 3 9RD ENGLAND
TK1864	INTERFET CORP	322 GOLD ST	GARLAND TX 75042
TK1913	WIMA THE INTER–TECHNICAL GROUP IND	ONE BRIDGE ST PO BOX 23	IRVINGTON NY 10533
TK2378	WONG'S ELECTRONICS CO., LTD WONG'S IND CENTRE	180A WAI YIP STREET KWUN TONG	KOWLOON, HONG KONG
U1395	WELWYN ELECTRIC	BEDLINGTON	NORTHUMBERLAND NE22 7AA ENGLAND
U3771	STANLER COMPONENTS BUSINESS CENTRE	HEY LANE	BRAINTREE ENGLAND
U4144	MURATA ELECTRONICS UK LTD	SOUTHWOOD FARNBOROUGH	HANTS ENGLAND
01121	ALLEN–BRADLEY CO	1201 S 2ND ST	MILWAUKEE WI 53204–2410
01295	TEXAS INSTRUMENTS INC SEMICONDUCTOR GROUP	13500 N CENTRAL EXPY PO BOX 655012	DALLAS TX 75265
01537	MOTOROLA COMMUNICATIONS AND ELECTRONICS INC	2553 N EDGINGTON ST	FRANKLIN PARK IL 60131–3401
02114	AMPEREX ELECTRONIC CORP FERROXCUBE DIV	5083 KINGS HWY	SAUGERTIES NY 12477
02735	RCA CORP SOLID STATE DIVISION	ROUTE 202	SOMERVILLE NJ 08876
03888	KDI ELECTRONICS	60 S JEFFERSON RD	WHIPPANY NJ 07981–1001
04222	AVX CERAMICS DIV OF AVX CORP	19TH AVE SOUTH P O BOX 867	MYRTLE BEACH SC 29577
04426	ITW SWITCHES DIV OF ILLINOIS TOOL WORKS INC	6615 W IRVING PARK RD	CHICAGO IL 60634–2410
04713	MOTOROLA INC SEMICONDUCTOR PRODUCTS SECTOR	5005 E MCDOWELL RD	PHOENIX AZ 85008–4229
06665	PRECISION MONOLITHICS INC SUB OF BOURNS INC	1500 SPACE PARK DR	SANTA CLARA CA 95050
07263	FAIRCHILD SEMICONDUCTOR CORP NORTH AMERICAN SALES SUB OF SCHLUMBERGER LTD MS 118	10400 RIDGEVIEW CT	CUPERTINO CA 95014
09353	C AND K COMPONENTS INC	15 RIVERDALE AVE	NEWTON MA 02158–1057
09922	BURNDY CORP	RICHARDS AVE	NORWALK CT 06852

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
12697	CLAROSTAT MFG CO INC	LOWER WASHINGTON ST	DOVER NH 03820
12954	MICROSEMI CORP - SCOTTSDALE	8700 E THOMAS RD P O BOX 1390	SCOTTSDALE AZ 85252
14552	MICROSEMI CORP	2830 S FAIRVIEW ST	SANTA ANA CA 92704-5948
14752	ELECTRO CUBE INC	1710 S DEL MAR AVE	SAN GABRIEL CA 91776-3825
18324	SIGNETICS CORP MILITARY PRODUCTS DIV	4130 S MARKET COURT	SACRAMENTO CA 95834-1222
18796	MURATA ERIE NORTH AMERICAN INC STATE COLLEGE OPERATIONS	1900 W COLLEGE AVE	STATE COLLEGE PA 16801-2723
19396	ILLINOIS TOOL WORKS INC PAKTRON DIV	1205 MCCONVILLE RD PO BOX 4539	LYNCHBURG VA 24502-4535
19701	MEPCO/CENTRALAB A NORTH AMERICAN PHILIPS CO MINERAL WELLS AIRPORT	PO BOX 760	MINERAL WELLS TX 76067-0760
24546	CORNING GLASS WORKS	550 HIGH ST	BRADFORD PA 16701-3737
25403	AMPEREX ELECTRONIC CORP SEMICONDUCTOR SOLID STATE AND ACTIVE DEVICES-ELECTRO OPTICAL DEVICES	GEORGE WASHINGTON HWY	SMITHFIELD RI 02917
27014	NATIONAL SEMICONDUCTOR CORP	2900 SEMICONDUCTOR DR	SANTA CLARA CA 95051-0606
29454	JOHANSON DIELECTRICS INC	2210 SCREENLAND DR PO BOX 6465	BURBANK CA 91505-1137
31433	KEMET ELECTRONICS CORP NATIONAL SALES HEADQUARTERS	PO BOX 5928	GREENVILLE SC 29606
31918	ITT SCHADOW INC	8081 WALLACE RD	EDEN PRAIRIE MN 55344-2224
50434	HEWLETT-PACKARD CO OPTOELECTRONICS DIV	370 W TRIMBLE RD	SAN JOSE CA 95131
52763	STETCO INC	3344 SCHIERHORN	FRANKLIN PARK IL 60131
56289	SPRAGUE ELECTRIC CO WORLD HEADQUARTERS	92 HAYDEN AVE	LEXINGTON MA 02173-7929
57668	ROHM CORP	8 WHATNEY PO BOX 19515	IRVINE CA 92713
59660	TUSONIX INC	7741 N BUSINESS PARK DR PO BOX 37144	TUCSON AZ 85740-7144
71400	BUSSMANN DIV OF COOPER INDUSTRIES INC	114 OLD STATE RD PO BOX 14460	ST LOUIS MO 63178
72982	ERIE SPECIALTY PRODUCTS INC	645 W 11TH ST	ERIE PA 16512
75042	IRC ELECTRONIC COMPONENTS PHILADELPHIA DIV TRW FIXED RESISTORS	401 N BROAD ST	PHILADELPHIA PA 19108-1001
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1	671–1600–00			CIRCUIT BD KIT:MAIN	80009	671160000
A2	671–1604–00			CIRCUIT BD ASSY:A2 ATTENUATOR	80009	671160400
A3	671–1605–00			CIRCUIT BD ASSY:A3 FRONT PANEL	80009	671160500
A4	671–1606–00			CIRCUIT BD ASSY:A4 POWER	80009	671160600
A5	671–1607–00			CIRCUIT BD ASSY:A5 FOCUS	80009	671160700
A6	671–1608–00			CIRCUIT BD ASSY:A6 CURSOR	80009	671160800
A7	671–1609–00			CIRCUIT BD ASSY:A7 INTENSITY	80009	671160900
A8	671–1878–00			CIRCUIT BD ASSY:TRANSISTOR	80009	671187800
A10	671–1610–00			CIRCUIT BD ASSY:A10 STORAGE	80009	671161000
A11	671–1612–00			CIRCUIT BD ASSY:A11 CURSOR	80009	671161200
A21	671–1611–00			CIRCUIT BD ASSY:SIO	80009	671161100

Component Number	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1	671-1600-00			CIRCUIT BD KIT:MAIN	80009	671160000
A1B1	119-3295-00			FAN,TUBEAXIAL:12V,1.2W,22CFM	S0319	MMF08B12PM
A1C101	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C102	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C103	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C105	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C106	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C107	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C108	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C110	281-0810-00			CAP,FXD,CER DI:5.6PF,+/-0.5PF,100V	04222	SA101A5R6DAA
A1C111	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	TK1743	CGB103KEX
A1C112	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	TK1743	CGB103KEX
A1C114	281-0767-00			CAP,FXD,CER DI:330PF,20%,100V	04222	SA102C331MAA
A1C115	281-0767-00			CAP,FXD,CER DI:330PF,20%,100V	04222	SA102C331MAA
A1C116	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C124	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C125	281-0772-00			CAP,FXD,CER DI:4700PF,10%,100V	04222	SA101C472KAA
A1C126	283-0114-02			CAP,FXD,CER DI:1500PF,5%,200V	59660	805-405-Y5D0-15
A1C130	283-0107-00			CAP,FXD,CER DI:51PF,5%,200V	04222	SR202A510JAA
A1C131	281-0763-00			CAP,FXD,CER DI:47PF,10%,100V	04222	SA101A470KAA
A1C133	281-0785-00			CAP,FXD,CER DI:68PF,10%,100V	04222	SA101A680KAA
A1C134	281-0756-00			CAP,FXD,CER DI:2.2PF,+/-0.5PF,200V	04222	SA102A2R2DAA
A1C140	281-0756-00			CAP,FXD,CER DI:2.2PF,+/-0.5PF,200V	04222	SA102A2R2DAA
A1C146	281-0756-00			CAP,FXD,CER DI:2.2PF,+/-0.5PF,200V	04222	SA102A2R2DAA
A1C148	281-0756-00			CAP,FXD,CER DI:2.2PF,+/-0.5PF,200V	04222	SA102A2R2DAA
A1C153	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	TK1743	CGB103KEX
A1C156	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C157	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C160	281-0810-00			CAP,FXD,CER DI:5.6PF,+/-0.5PF,100V	04222	SA101A5R6DAA
A1C164	281-0865-00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A1C165	281-0865-00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A1C174	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C175	281-0772-00			CAP,FXD,CER DI:4700PF,10%,100V	04222	SA101C472KAA
A1C176	283-0114-02			CAP,FXD,CER DI:1500PF,5%,200V	59660	805-405-Y5D0-15
A1C180	281-0158-00			CAP,VAR,CER DI:7-45PF,100WVDC SUBMIN CER DI	59660	518-006 G 7-45
A1C181	281-0763-00			CAP,FXD,CER DI:47PF,10%,100V	04222	SA101A470KAA
A1C182	281-0758-00	200909		CAP,FXD,CER DI:15PF,20%,100V	04222	SA102A150MAA
A1C216	281-0756-00			CAP,FXD,CER DI:2.2PF,+/-0.5PF,200V	04222	SA102A2R2DAA
A1C217	281-0756-00			CAP,FXD,CER DI:2.2PF,+/-0.5PF,200V	04222	SA102A2R2DAA
A1C220	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C225	281-0758-00			CAP,FXD,CER DI:15PF,20%,100V	04222	SA102A150MAA
A1C237	281-0140-00			CAP,VAR,CER DI:5-25PF,100V	59660	518-038A-5-25
A1C239	281-0767-00			CAP,FXD,CER DI:330PF,20%,100V	04222	SA102C331MAA
A1C240	281-0785-00			CAP,FXD,CER DI:68PF,10%,100V	04222	SA101A680KAA
A1C241	281-0785-00			CAP,FXD,CER DI:68PF,10%,100V	04222	SA101A680KAA
A1C250	281-0768-00			CAP,FXD,CER DI:470PF,20%,100V	04222	SA101A471KAA
A1C251	281-0768-00			CAP,FXD,CER DI:470PF,20%,100V	04222	SA101A471KAA
A1C255	281-0865-00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A1C256	281-0214-00			CAP,VAR,CER DI:0.6-3PF,400V	52763	313613-140
A1C257	281-0214-00			CAP,VAR,CER DI:0.6-3PF,400V	52763	313613-140
A1C258	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C283	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C284	281-0762-00	201954		CAP,FXD,CER DI:27PF,20%,100V	04222	SA101A270MAA
A1C310	281-0865-00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A1C311	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA

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A1C323	281–0775–01	200305		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C327	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C335	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A1C340	281–0762–00			CAP,FXD,CER DI:27PF,20%,100V	04222	SA101A270MAA
A1C349	285–1385–00			CAP,FXD,PLASTIC:43PF,2.5%,630V	K7779	B31063–A6430–H6
A1C353	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A1C362	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C366	281–0762–00			CAP,FXD,CER DI:27PF,20%,100V	04222	SA101A270MAA
A1C369	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C372	281–0815–00			CAP,FXD,CER DI:0.027UF,20%,50V	04222	SA205C273MAA
A1C380	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C384	290–1159–00			CAP,FXD,ELCTLT:1000UF,20%,16V	TK0ED	TWSS
A1C387	281–0762–00			CAP,FXD,CER DI:27PF,20%,100V	04222	SA101A270MAA
A1C389	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C396	281–0814–00			CAP,FXD,CER DI:100 PF,10%,100V	TK1743	CGB101KEN
A1C397	281–0774–00			CAP,FXD,CER DI:0.022MFD,20%,100V	04222	SA201E223MAA
A1C398	281–0774–00			CAP,FXD,CER DI:0.022MFD,20%,100V	04222	SA201E223MAA
A1C400	281–0762–00			CAP,FXD,CER DI:27PF,20%,100V	04222	SA101A270MAA
A1C401	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C408	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C418	290–1150–00			CAP,FXD,ELCTLT:15UF,+50%–10%,16WVDC	K8996	030–25159
A1C424	281–0775–01	200305		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C430	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C431	290–1150–00			CAP,FXD,ELCTLT:15UF,+50%–10%,16WVDC	K8996	030–25159
A1C435	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C439	281–0773–00			CAP,FXD,CER DI:0.01UF,10%,100V	TK1743	CGB103KEX
A1C451	281–0773–00			CAP,FXD,CER DI:0.01UF,10%,100V	TK1743	CGB103KEX
A1C452	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C455	290–1150–00			CAP,FXD,ELCTLT:15UF,+50%–10%,16WVDC	K8996	030–25159
A1C460	281–0814–00			CAP,FXD,CER DI:100 PF,10%,100V	TK1743	CGB101KEN
A1C462	290–0743–00			CAP,FXD,ELCTLT:100UF,+50%–20%,16WVDC	TK0900	SME16T101M6X16L
A1C472	290–1210–00			CAP,FXD,ELCTLT:10UF,10V	S5085	ORDER BY DESCRI
A1C473	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A1C474	281–0898–00			CAP,FXD,CER DI:7.5PF,+/–0.5PF,500V	04222	SA107A7R5DAA
A1C480	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C481	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C489	281–0810–00			CAP,FXD,CER DI:5.6PF,+/–0.5PF,100V	04222	SA101A5R6DAA
A1C495	281–0773–00			CAP,FXD,CER DI:0.01UF,10%,100V	TK1743	CGB103KEX
A1C496	281–0773–00			CAP,FXD,CER DI:0.01UF,10%,100V	TK1743	CGB103KEX
A1C500	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C501	281–0810–00			CAP,FXD,CER DI:5.6PF,+/–0.5PF,100V	04222	SA101A5R6DAA
A1C503	281–0772–00			CAP,FXD,CER DI:4700PF,10%,100V	04222	SA101C472KAA
A1C504	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C505	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C506	281–0767–00			CAP,FXD,CER DI:330PF,20%,100V	04222	SA102C331MAA
A1C507	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C520	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C525	281–0758–00			CAP,FXD,CER DI:15PF,20%,100V	04222	SA102A150MAA
A1C530	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C535	281–0812–00			CAP,FXD,CER DI:1000PF,10%,100V	04222	SA101C102KAA
A1C536	281–0814–00			CAP,FXD,CER DI:100 PF,10%,100V	TK1743	CGB101KEN
A1C537	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C538	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A1C539	281–0865–00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A1C540	290–1153–00			CAP,FXD,ELCTLT:47UF,+50–10%,10V	K8996	030–24479

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A1C545	283-0119-02			CAP,FXD,CER DI:2200PF,5%,200V	59660	855-403-Y5E0-22
A1C546	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C547	281-0767-00			CAP,FXD,CER DI:330PF,20%,100V	04222	SA102C331MAA
A1C550	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C554	281-0865-00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A1C555	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C557	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C558	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C560	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C561	281-0865-00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A1C562	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C570	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C571	281-0785-00			CAP,FXD,CER DI:68PF,10%,100V	04222	SA101A680KAA
A1C572	281-0758-00			CAP,FXD,CER DI:15PF,20%,100V	04222	SA102A150MAA
A1C584	285-1341-00			CAP,FXD,PLASTIC:METALIZED FILM;0.1UF,205,10	TK1913	MKS2 0.1/100/20
A1C587	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	TK1743	CGB103KEX
A1C600	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C601	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C602	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C604	281-0768-00			CAP,FXD,CER DI:470PF,20%,100V	04222	SA101A471KAA
A1C608	281-0814-00			CAP,FXD,CER DI:100 PF,10%,100V	TK1743	CGB101KEN
A1C776	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	TK1743	CGB103KEX
A1C780	281-0771-00			CAP,FXD,CER DI:2200PF,20%,200V	04222	SA106E222MAA
A1C782	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C784	281-0214-00			CAP,VAR,CER DI:0.6-3PF,400V	52763	313613-140
A1C785	285-1101-00			CAP,FXD,PLASTIC:0.022UF,10%,200V	19396	223K02PT485
A1C789	281-0771-00			CAP,FXD,CER DI:2200PF,20%,200V	04222	SA106E222MAA
A1C794	281-0214-00			CAP,VAR,CER DI:0.6-3PF,400V	52763	313613-140
A1C795	285-1101-00			CAP,FXD,PLASTIC:0.022UF,10%,200V	19396	223K02PT485
A1C799	281-0771-00			CAP,FXD,CER DI:2200PF,20%,200V	04222	SA106E222MAA
A1C817	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C824	281-0785-00			CAP,FXD,CER DI:68PF,10%,100V	04222	SA101A680KAA
A1C828	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C832	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C834	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C835	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C845	281-0768-00			CAP,FXD,CER DI:470PF,20%,100V	04222	SA101A471KAA
A1C846	281-0772-00			CAP,FXD,CER DI:4700PF,10%,100V	04222	SA101C472KAA
A1C847	285-1341-00			CAP,FXD,PLASTIC:METALIZED FILM;0.1UF,205,10	TK1913	MKS2 0.1/100/20
A1C849	285-1341-00			CAP,FXD,PLASTIC:METALIZED FILM;0.1UF,205,10	TK1913	MKS2 0.1/100/20
A1C851	285-1341-00			CAP,FXD,PLASTIC:METALIZED FILM;0.1UF,205,10	TK1913	MKS2 0.1/100/20
A1C853	281-0767-00			CAP,FXD,CER DI:330PF,20%,100V	04222	SA102C331MAA
A1C854	283-0279-00			CAP,FXD,CER DI:0.001UF,20%,3000V	18796	DHR12Y5S102M3KV
A1C855	285-1255-00			CAP,FXD,PLASTIC:0.01UF,20%,3KV	56289	430P582
A1C871	285-1341-00			CAP,FXD,PLASTIC:METALIZED FILM;0.1UF,205,10	TK1913	MKS2 0.1/100/20
A1C875	285-1341-00			CAP,FXD,PLASTIC:METALIZED FILM;0.1UF,205,10	TK1913	MKS2 0.1/100/20
A1C893	283-0279-00			CAP,FXD,CER DI:0.001UF,20%,3000V	18796	DHR12Y5S102M3KV
A1C901	281-0815-00			CAP,FXD,CER DI:0.027UF,20%,50V	04222	SA205C273MAA
A1C902	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C908	281-0865-00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A1C909	281-0767-00			CAP,FXD,CER DI:330PF,20%,100V	04222	SA102C331MAA
A1C910	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C912	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C913	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	TK1743	CGB103KEX
A1C914	290-1223-00			CAP,FXD,ELCTLT:0.47UF,50V	80009	290122300

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A1C915	290-0768-00			CAP,FXD,ELCTLT:10UF,+50-20%,100WVDC	TK0900	SL100VB10RT10X1
A1C924	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C927	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C932	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C933	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C939	281-0767-00			CAP,FXD,CER DI:330PF,20%,100V	04222	SA102C331MAA
A1C940	281-0865-00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A1C941	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C942	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C952	281-0814-00			CAP,FXD,CER DI:100 PF,10%,100V	TK1743	CGB101KEN
A1C953	290-1153-00			CAP,FXD,ELCTLT:47UF,+50-10%,10V	K8996	030-24479
A1C962	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C963	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C970	281-0865-00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A1C971	290-0831-00			CAP,FXD,ELCTLT:470UF,+50-20%,50V	TK0900	KMC100VB471M18X
A1C972	290-0922-00			CAP,FXD,ELCTLT:1000UF,20%,50V	TK0900	SM50VB102Q16X31
A1C975	285-1255-00			CAP,FXD,PLASTIC:0.01UF,20%,3KV	56289	430P582
A1C976	285-1255-00			CAP,FXD,PLASTIC:0.01UF,20%,3KV	56289	430P582
A1C979	285-1255-00			CAP,FXD,PLASTIC:0.01UF,20%,3KV	56289	430P582
A1C982	281-0814-00			CAP,FXD,CER DI:100 PF,10%,100V	TK1743	CGB101KEN
A1C983	290-1153-00			CAP,FXD,ELCTLT:47UF,+50-10%,10V	K8996	030-24479
A1C984	290-0947-00			CAP,FXD,ELCTLT:33UF,+50-10%,160V W/SLEEVE	TK1424	CEUSM2C330-Q
A1C986	290-1159-00			CAP,FXD,ELCTLT:1000UF,20%,16V	TK0ED	TWSS
A1C987	290-1159-00			CAP,FXD,ELCTLT:1000UF,20%,16V	TK0ED	TWSS
A1C988	290-1159-00			CAP,FXD,ELCTLT:1000UF,20%,16V	TK0ED	TWSS
A1C989	290-1159-00			CAP,FXD,ELCTLT:1000UF,20%,16V	TK0ED	TWSS
A1C990	290-1159-00			CAP,FXD,ELCTLT:1000UF,20%,16V	TK0ED	TWSS
A1C991	290-1159-00			CAP,FXD,ELCTLT:1000UF,20%,16V	TK0ED	TWSS
A1C992	290-1159-00			CAP,FXD,ELCTLT:1000UF,20%,16V	TK0ED	TWSS
A1C993	290-1159-00			CAP,FXD,ELCTLT:1000UF,20%,16V	TK0ED	TWSS
A1C994	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C995	290-1159-00			CAP,FXD,ELCTLT:1000UF,20%,16V	TK0ED	TWSS
A1C996	290-1159-00			CAP,FXD,ELCTLT:1000UF,20%,16V	TK0ED	TWSS
A1C1052	281-0775-01	200213		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C1053	281-0775-01	200213		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C1406	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C1440	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C1443	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C1451	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C1452	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C1496	281-0763-00			CAP,FXD,CER DI:47PF,10%,100V	04222	SA101A470KAA
A1C1497	281-0763-00			CAP,FXD,CER DI:47PF,10%,100V	04222	SA101A470KAA
A1CR104	152-0322-00			SEMICOND DVC,DI:SCHOTTKY,SI,15V,1.2PF,DO-35	50434	5082-2672
A1CR105	152-0322-00			SEMICOND DVC,DI:SCHOTTKY,SI,15V,1.2PF,DO-35	50434	5082-2672
A1CR111	152-0725-00			SEMICOND DVC,DI:SI,SCHOTTKY,20V,1.2PF,DO-35	50434	5082-2810 OPT.
A1CR112	152-0725-00			SEMICOND DVC,DI:SI,SCHOTTKY,20V,1.2PF,DO-35	50434	5082-2810 OPT.
A1CR133	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR136	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR139	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR154	152-0322-00			SEMICOND DVC,DI:SCHOTTKY,SI,15V,1.2PF,DO-35	50434	5082-2672
A1CR155	152-0322-00			SEMICOND DVC,DI:SCHOTTKY,SI,15V,1.2PF,DO-35	50434	5082-2672
A1CR161	152-0725-00			SEMICOND DVC,DI:SI,SCHOTTKY,20V,1.2PF,DO-35	50434	5082-2810 OPT.
A1CR162	152-0725-00			SEMICOND DVC,DI:SI,SCHOTTKY,20V,1.2PF,DO-35	50434	5082-2810 OPT.
A1CR183	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR186	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1CR189	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR277	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR278	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR282	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR283	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR300	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR301	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR302	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR303	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR304	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR308	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR319	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR344	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR347	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR348	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR349	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR369	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR370	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR381	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR417	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR420	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR421	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR431	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR432	152-0322-00			SEMICOND DVC,DI:SCHOTTKY,SI,15V,1.2PF,DO-35	50434	5082-2672
A1CR435	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR438	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR440	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR441	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR442	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR443	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR444	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR445	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR446	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR447	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR474	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR475	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR476	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR477	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR521	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR530	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR539	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR540	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR546	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR562	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR566	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR570	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR571	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR584	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR588	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR589	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR603	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR604	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR776	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR780	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A1CR781	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1CR790	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR791	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR805	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR806	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR807	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR814	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR815	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR816	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR817	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR818	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR819	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR820	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR821	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR822	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR823	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR827	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR828	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR840	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR845	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR851	152–0242–00			SEMICOND DVC,DI:SIG,SI,225V,0.2A,DO–7	07263	FDH5004
A1CR853	152–0242–00			SEMICOND DVC,DI:SIG,SI,225V,0.2A,DO–7	07263	FDH5004
A1CR854	152–0242–00			SEMICOND DVC,DI:SIG,SI,225V,0.2A,DO–7	07263	FDH5004
A1CR855	152–0242–00			SEMICOND DVC,DI:SIG,SI,225V,0.2A,DO–7	07263	FDH5004
A1CR912	152–0808–00			DIODE,RECT:,ULTRA FAST;400V,1.5A,50NS;BYD73	25403	BYD73G
A1CR915	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR923	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR924	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR933	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR953	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR983	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A1CR984	152–0414–00			DIODE,RECT:,;200V,1.0A,750NS;MR812,TR	80009	152041400
A1CR985	152–0414–00			DIODE,RECT:,;200V,1.0A,750NS;MR812,TR	80009	152041400
A1CR986	152–0414–00			DIODE,RECT:,;200V,1.0A,750NS;MR812,TR	80009	152041400
A1CR987	152–0414–00			DIODE,RECT:,;200V,1.0A,750NS;MR812,TR	80009	152041400
A1CR988	152–0414–00			DIODE,RECT:,;200V,1.0A,750NS;MR812,TR	80009	152041400
A1CR989	152–0414–00			DIODE,RECT:,;200V,1.0A,750NS;MR812,TR	80009	152041400
A1CR990	152–0582–00			DIODE,RECT:SCHTKY,;20V,3A,.475VF;1N5820	04713	1N5820
A1CR991	152–0414–00			DIODE,RECT:,;200V,1.0A,750NS;MR812,TR	80009	152041400
A1CR992	152–0414–00			DIODE,RECT:,;200V,1.0A,750NS;MR812,TR	80009	152041400
A1CR993	152–0582–00			DIODE,RECT:SCHTKY,;20V,3A,.475VF;1N5820	04713	1N5820
A1CR994	152–0601–01			SEMICOND DVC,DI:RECTIFIER,SI,150V,1A,35NS	04713	MUR115RL
A1CR995	152–0601–01			SEMICOND DVC,DI:RECTIFIER,SI,150V,1A,35NS	04713	MUR115RL
A1DL224	119–2620–00			DELAY LINE,ELEC:93NS,175 OHM	80009	119262000
A1DS856	150–0035–00			LAMP,GLOW:90V MAX,0.3MA,AID–T,WIRE LD	TK0213	JH005/3011JA
A1DS858	150–0035–00			LAMP,GLOW:90V MAX,0.3MA,AID–T,WIRE LD	TK0213	JH005/3011JA
A1DS870	150–0035–00			LAMP,GLOW:90V MAX,0.3MA,AID–T,WIRE LD	TK0213	JH005/3011JA
A1E102	276–0532–00			SHLD BEAD,ELEK:FERRITE	02114	56–590–65/4A6
A1E103	276–0532–00			SHLD BEAD,ELEK:FERRITE	02114	56–590–65/4A6
A1E130	276–0752–00			CORE,EM:FERRITE	TK1442	BP53–BH3.5X10X4
A1E131	276–0752–00			CORE,EM:FERRITE	TK1442	BP53–BH3.5X10X4
A1E152	276–0532–00			SHLD BEAD,ELEK:FERRITE	02114	56–590–65/4A6
A1E153	276–0532–00			SHLD BEAD,ELEK:FERRITE	02114	56–590–65/4A6
A1E180	276–0752–00			CORE,EM:FERRITE	TK1442	BP53–BH3.5X10X4
A1E181	276–0752–00			CORE,EM:FERRITE	TK1442	BP53–BH3.5X10X4
A1J1	204–1034–00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TK0EM	52011–0610

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A1J2	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TK0EM	52011-0610
A1J3	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TK0EM	52011-0610
A1J4	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TK0EM	52011-0610
A1J5	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TK0EM	52011-0610
A1J6	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TK0EM	52011-0610
A1J800	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TK0EM	52011-0610
A1J1001	204-1033-00			CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TK0EM	52011-0410
A1J1002	204-1033-00			CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TK0EM	52011-0410
A1L278	120-1631-00			COIL,RF:FXD,210UH	TK00A	ORDER BY DESCRI
A1L910	108-1464-00			INDUCTOR,CHOKE:562UH	80009	108146400
A1L970	108-1375-00			COIL,RF:FXD,82UH,1A	TK00A	RL-1218-820K-1A
A1L986	108-1375-00			COIL,RF:FXD,82UH,1A	TK00A	RL-1218-820K-1A
A1L988	108-1375-00			COIL,RF:FXD,82UH,1A	TK00A	RL-1218-820K-1A
A1L990	108-1416-00			COIL,RF:POWER INDUCTOR,300UH-400UH,3A	TK2378	ORDER BY DESCRI
A1L991	120-1631-00			COIL,RF:FXD,210UH	TK00A	ORDER BY DESCRI
A1L995	108-1416-00			COIL,RF:POWER INDUCTOR,300UH-400UH,3A	TK2378	ORDER BY DESCRI
A1Q102	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A1Q103	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A1Q104	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q105	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q106	151-0711-01			TRANSISTOR:NPN,SI,TO-92	04713	SPS8608M
A1Q107	151-0711-01			TRANSISTOR:NPN,SI,TO-92	04713	SPS8608M
A1Q114	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q115	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q152	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A1Q153	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A1Q154	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q155	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q156	151-0711-01			TRANSISTOR:NPN,SI,TO-92	04713	SPS8608M
A1Q157	151-0711-01			TRANSISTOR:NPN,SI,TO-92	04713	SPS8608M
A1Q164	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q165	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q200	151-0711-01			TRANSISTOR:NPN,SI,TO-92	04713	SPS8608M
A1Q201	151-0711-01			TRANSISTOR:NPN,SI,TO-92	04713	SPS8608M
A1Q202	151-0711-00			TRANSISTOR:NPN,SI,TO-92B	04713	SPS8224 (MPSH10
A1Q203	151-0711-00			TRANSISTOR:NPN,SI,TO-92B	04713	SPS8224 (MPSH10
A1Q206	151-0221-00			TRANSISTOR,SIG:BIPOLAR,PNP;12V,80MA,SWITCHI	04713	SPS246(EL8251)
A1Q207	151-0221-00			TRANSISTOR,SIG:BIPOLAR,PNP;12V,80MA,SWITCHI	04713	SPS246(EL8251)
A1Q230	151-0221-00			TRANSISTOR,SIG:BIPOLAR,PNP;12V,80MA,SWITCHI	04713	SPS246(EL8251)
A1Q231	151-0221-00			TRANSISTOR,SIG:BIPOLAR,PNP;12V,80MA,SWITCHI	04713	SPS246(EL8251)
A1Q232	151-0221-08			TRANSISTOR,SIG:BIPOLAR,PNP;12V,80MA,SWITCHI	04713	SPS246RLRP (EL8
A1Q233	151-0221-08			TRANSISTOR,SIG:BIPOLAR,PNP;12V,80MA,SWITCHI	04713	SPS246RLRP (EL8
A1Q254	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q255	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q256	151-0869-00			TRANSISTOR:NPN,SI,TO-39	TK0EF	2N3866
A1Q257	151-0869-00			TRANSISTOR:NPN,SI,TO-39	TK0EF	2N3866
A1Q277	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A1Q283	151-0736-00			TRANSISTOR:NPN,SI,TO-92	TK1016	2N4401
A1Q284	151-0711-01			TRANSISTOR:NPN,SI,TO-92	04713	SPS8608M
A1Q285	151-0711-01			TRANSISTOR:NPN,SI,TO-92	04713	SPS8608M
A1Q327	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A1Q363	151-0711-01			TRANSISTOR:NPN,SI,TO-92	04713	SPS8608M
A1Q365	151-0711-01			TRANSISTOR:NPN,SI,TO-92	04713	SPS8608M
A1Q366	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A1Q367	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223

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A1Q400	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A1Q401	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A1Q415	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A1Q420	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q435	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A1Q440	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A1Q487	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A1Q488	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A1Q489	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A1Q514	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A1Q535	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A1Q536	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A1Q601	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q602	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q770	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A1Q775	151-0347-02			TRANSISTOR:NPN,SI,TO-92	04713	2N5551 RLRP (AM
A1Q776	151-0350-00			TRANSISTOR:PNP,SI,TO-92	TK1016	TO BE ASSIGNED
A1Q779	151-0350-00			TRANSISTOR:PNP,SI,TO-92	TK1016	TO BE ASSIGNED
A1Q780	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q785	151-0347-02			TRANSISTOR:NPN,SI,TO-92	04713	2N5551 RLRP (AM
A1Q789	151-0350-00			TRANSISTOR:PNP,SI,TO-92	TK1016	TO BE ASSIGNED
A1Q801	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q802	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q803	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q804	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A1Q805	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A1Q817	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q825	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A1Q835	151-0199-00			TRANSISTOR,SIG:BIPOLAR,PNP;12V,80MA,SWITCHI	27014	PN3640
A1Q840	151-0347-02			TRANSISTOR:NPN,SI,TO-92	04713	2N5551 RLRP (AM
A1Q845	151-0350-00			TRANSISTOR:PNP,SI,TO-92	TK1016	TO BE ASSIGNED
A1Q911	151-0347-02			TRANSISTOR:NPN,SI,TO-92	04713	2N5551 RLRP (AM
A1Q912	151-0462-00			TRANSISTOR:PNP,SI,TO-220	04713	TIP30C
A1Q913	151-0462-00			TRANSISTOR:PNP,SI,TO-220	04713	TIP30C
A1Q918	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A1Q921	151-0350-00			TRANSISTOR:PNP,SI,TO-92	TK1016	TO BE ASSIGNED
A1Q923	151-0476-02			TRANSISTOR:SELECTED	04713	SJE389
A1Q930	151-0424-00			TRANSISTOR:NPN,SI,TO-92	07263	S039118
A1Q940	151-0347-02			TRANSISTOR:NPN,SI,TO-92	04713	2N5551 RLRP (AM
A1Q950	151-0462-00			TRANSISTOR:PNP,SI,TO-220	04713	TIP30C
A1Q960	151-0424-00			TRANSISTOR:NPN,SI,TO-92	07263	S039118
A1Q970	151-0347-02			TRANSISTOR:NPN,SI,TO-92	04713	2N5551 RLRP (AM
A1Q980	151-0462-00			TRANSISTOR:PNP,SI,TO-220	04713	TIP30C
A1R100	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R101	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R102	321-0155-00			RES,FXD,FILM:402 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R103	321-0155-00			RES,FXD,FILM:402 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R104	321-0089-00			RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R105	321-0089-00			RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R106	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R107	311-2355-00			RES,VAR,NONWW:TRMR,100 OHM,20%,0.5W	K8788	TC10-LV10-100R/
A1R108	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R109	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R110	321-0197-00			RES,FXD,FILM:1.10K OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A1R111	321-0197-00			RES,FXD,FILM:1.10K OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1

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A1R112	311-2361-00			RES,VAR,NONWW:TRMR,10K OHM,0.5W	K8788	TC10-LV10-10K/A
A1R114	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R115	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R117	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R118	315-0821-00			RES,FXD,FILM:820 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R119	315-0821-00			RES,FXD,FILM:820 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R120	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A1R121	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A1R122	321-0089-00			RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R124	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R125	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R126	315-0162-00			RES,FXD,FILM:1.6K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R127	321-0063-00			RES,FXD,FILM:44.2 OHM,0.5%,0.125W,TC=T0	57668	CRB14 FXE 44.2
A1R128	315-0752-00			RES,FXD,FILM:7.5K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R130	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R131	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R132	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R133	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R134	321-0178-00			RES,FXD,FILM:698 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A1R135	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R136	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R137	321-0109-00			RES,FXD,FILM:133 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A1R138	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R139	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R140	321-0178-00			RES,FXD,FILM:698 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A1R141	311-2364-00			RES,VAR,NONWW:TRMR,4.7K OHM,0.5W	K8788	TC10-LV10-4K7/A
A1R142	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R143	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R144	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R145	311-2364-00			RES,VAR,NONWW:TRMR,4.7K OHM,0.5W	K8788	TC10-LV10-4K7/A
A1R146	321-0178-00			RES,FXD,FILM:698 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A1R147	321-0109-00			RES,FXD,FILM:133 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A1R148	321-0178-00			RES,FXD,FILM:698 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A1R150	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R151	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R152	321-0155-00			RES,FXD,FILM:402 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R153	321-0155-00			RES,FXD,FILM:402 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R154	321-0089-00			RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R155	321-0089-00			RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R156	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R157	311-2355-00			RES,VAR,NONWW:TRMR,100 OHM,20%,0.5W	K8788	TC10-LV10-100R/
A1R158	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R159	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R160	321-0197-00			RES,FXD,FILM:1.10K OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A1R161	321-0197-00			RES,FXD,FILM:1.10K OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A1R162	311-2361-00			RES,VAR,NONWW:TRMR,10K OHM,0.5W	K8788	TC10-LV10-10K/A
A1R164	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R165	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R167	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R168	315-0821-00			RES,FXD,FILM:820 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R169	315-0821-00			RES,FXD,FILM:820 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R170	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A1R171	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A1R172	321-0089-00			RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R174	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	TK1727	SFR25 2322-181-

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A1R175	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R176	315-0162-00			RES,FXD,FILM:1.6K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R177	321-0063-00			RES,FXD,FILM:44.2 OHM,0.5%,0.125W,TC=T0	57668	CRB14 FXE 44.2
A1R178	315-0752-00			RES,FXD,FILM:7.5K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R180	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R181	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R182	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R183	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R185	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R186	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R188	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R189	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R192	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R193	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R194	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R195	311-2354-00			RES,VAR,NONWW:TRMR,4.7K OHM,0.5W	K8788	TC10-LH2.5-4K7/
A1R200	315-0561-00			RES,FXD,FILM:560 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R201	315-0561-00			RES,FXD,FILM:560 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R202	321-0178-00			RES,FXD,FILM:698 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A1R203	321-0178-00			RES,FXD,FILM:698 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A1R204	321-0089-00			RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R206	315-0271-00			RES,FXD,FILM:270 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R207	315-0271-00			RES,FXD,FILM:270 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R212	321-0657-00			RES,FXD,FILM:60 OHM,1%,0.125W,TC=T0	57668	CRB14 FXE 60 OH
A1R213	321-0657-00			RES,FXD,FILM:60 OHM,1%,0.125W,TC=T0	57668	CRB14 FXE 60 OH
A1R215	315-0241-00			RES,FXD,FILM:240 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R216	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R217	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R218	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R219	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R220	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R221	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R222	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
A1R223	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
A1R224	315-0562-00	200445		RES,FXD,FILM:5.6K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R225	321-0253-00			RES,FXD,FILM:4.22K OHM,1%,0.125W,TC=T0	19701	5033ED 4K 220F
A1R226	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R227	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R228	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R229	315-0562-00	200445		RES,FXD,FILM:5.6K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R230	321-0093-00			RES,FXD,FILM:90.9 OHM,1%,0.125W,TC=T0	57668	CRB14 FXE 90.9
A1R231	321-0093-00			RES,FXD,FILM:90.9 OHM,1%,0.125W,TC=T0	57668	CRB14 FXE 90.9
A1R233	321-0089-00			RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R236	321-0172-00			RES,FXD,FILM:604 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A1R239	315-0162-00			RES,FXD,FILM:1.6K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R240	311-2365-00			RES,VAR,NONWW:TRMR,470 OHM,0.75W	K8788	TC10-LV10-470K/
A1R241	311-2364-00			RES,VAR,NONWW:TRMR,4.7K OHM,0.5W	K8788	TC10-LV10-4K7/A
A1R244	321-0175-00			RES,FXD,FILM:649 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A1R245	321-0175-00			RES,FXD,FILM:649 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A1R248	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R249	321-0274-00			RES,FXD,FILM:6.98K OHM,1%,0.125W,TC=T0	TK1727	2322-151-6K98
A1R250	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R251	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R252	321-0274-00			RES,FXD,FILM:6.98K OHM,1%,0.125W,TC=T0	TK1727	2322-151-6K98
A1R253	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4

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A1R256	307-1361-00			RES,FXD,FILM:2.2K OHM,1%,0.5W,TC=15PPM	K1439	MK3
A1R257	307-1361-00			RES,FXD,FILM:2.2K OHM,1%,0.5W,TC=15PPM	K1439	MK3
A1R258	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A1R259	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A1R261	307-1340-00			RES,FXD,FILM:22 OHM,5%,1W	K1439	5K/5
A1R262	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R266	308-0936-00			RES,FXD,WW:3300HM,5%,7W	U1395	ORDER BY DESCRI
A1R267	308-0936-00			RES,FXD,WW:3300HM,5%,7W	U1395	ORDER BY DESCRI
A1R272	301-0101-00			RES,FXD,FILM:100 OHM,5%,0.5W	TK1727	SFR30 2322-182-
A1R273	301-0101-00			RES,FXD,FILM:100 OHM,5%,0.5W	TK1727	SFR30 2322-182-
A1R277	321-0235-00			RES,FXD,FILM:2.74K OHM,1%,0.125W,TC=T0	19701	5043ED2K740F
A1R278	321-0231-00			RES,FXD,FILM:2.49K OHM,1%,0.125W,TC=T0	19701	5033ED2K49F
A1R279	321-0322-00			RES,FXD,FILM:22.1K OHM,0.1%,0.125W,TC=T0	19701	5033ED22K10F
A1R280	311-2362-00			RES,VAR,NONWW:PNL,4.7K OHM,20%,0.2W	K8996	PP17/000HFAOA36
A1R282	321-0306-00			RES,FXD,FILM:15.0K OHM,1%,0.125W,TC=T0	19701	5043ED15K00F
A1R283	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R284	321-0210-00			RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=T0	19701	5033ED1K50F
A1R285	321-0210-00			RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=T0	19701	5033ED1K50F
A1R286	315-0120-00			RES,FXD,FILM:12 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R287	315-0120-00			RES,FXD,FILM:12 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R288	321-0109-00			RES,FXD,FILM:133 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A1R289	321-0109-00			RES,FXD,FILM:133 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A1R290	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R291	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R292	321-0018-00			RES,FXD,FILM:15.0 OHM,1%,0.125W,TC=T0	57668	RB14FXE 15E0
A1R294	311-2365-00			RES,VAR,NONWW:TRMR,470 OHM,0.75W	K8788	TC10-LV10-470K/
A1R300	315-0273-00			RES,FXD,FILM:27K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R301	315-0273-00			RES,FXD,FILM:27K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R303	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
A1R304	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R308	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
A1R309	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R310	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R311	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R312	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R313	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R314	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R316	311-2364-00			RES,VAR,NONWW:TRMR,4.7K OHM,0.5W	K8788	TC10-LV10-4K7/A
A1R317	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A1R318	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R323	321-0205-00			RES,FXD,FILM:1.33K OHM,1%,0.125W,TC=T0	TK1727	MR25-2322-151-1
A1R324	321-0205-00			RES,FXD,FILM:1.33K OHM,1%,0.125W,TC=T0	TK1727	MR25-2322-151-1
A1R325	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R326	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R327	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R328	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R329	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R330	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R337	315-0242-00			RES,FXD,FILM:2.4K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R338	315-0242-00			RES,FXD,FILM:2.4K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R339	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R340	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R341	315-0681-00			RES,FXD,FILM:680 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R343	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R344	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-

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A1R345	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R346	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R347	315-0182-00			RES,FXD,FILM:1.8K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R348	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R349	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R351	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R352	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R353	315-0182-00			RES,FXD,FILM:1.8K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R355	315-0680-00			RES,FXD,FILM:68 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R356	315-0680-00			RES,FXD,FILM:68 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R357	315-0151-00			RES,FXD,FILM:150 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R359	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R360	311-2420-00			RES,VAR,NONWW:TRMR,10K	K8788	ORDER BY DESCRI
A1R361	321-0172-00			RES,FXD,FILM:604 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A1R362	315-0911-00			RES,FXD,FILM:910 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R363	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A1R364	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A1R366	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R367	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R368	315-0681-00			RES,FXD,FILM:680 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R369	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R375	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R380	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R381	315-0562-00			RES,FXD,FILM:5.6K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R384	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R385	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R386	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R387	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R388	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R390	315-0752-00			RES,FXD,FILM:7.5K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R391	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R392	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R393	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R394	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R395	311-2363-00			RES,VAR,NONWW:TRMR,1K OHM,0.5W	K8788	TC10-LV10-1K/A
A1R396	315-0182-00			RES,FXD,FILM:1.8K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R397	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R398	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R400	321-0089-00			RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R401	321-0089-00			RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R402	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R403	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R404	315-0120-00			RES,FXD,FILM:12 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R405	315-0120-00			RES,FXD,FILM:12 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R406	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R407	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R408	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R409	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R410	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R412	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R413	315-0562-00			RES,FXD,FILM:5.6K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R414	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R415	315-0120-00			RES,FXD,FILM:12 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R416	315-0204-00			RES,FXD,FILM:200K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R417	315-0562-00			RES,FXD,FILM:5.6K OHM,5%,0.25W	TK1727	SFR25 2322-181-

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1R418	315-0204-00			RES,FXD,FILM:200K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R419	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R420	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R421	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R422	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R433	321-0322-00			RES,FXD,FILM:22.1K OHM,0.1%,0.125W,TC=T0	19701	5033ED22K10F
A1R434	321-0155-00			RES,FXD,FILM:402 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R435	321-0155-00			RES,FXD,FILM:402 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R436	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R437	315-0752-00			RES,FXD,FILM:7.5K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R438	315-0204-00			RES,FXD,FILM:200K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R439	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R440	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R441	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R442	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R443	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R444	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R445	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R446	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R447	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R448	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R449	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R450	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R451	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R452	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R453	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R454	321-0361-00			RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=T0	19701	5043ED56K20F
A1R455	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R456	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R457	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R458	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R459	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R460	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R461	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R462	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R468	315-0204-00			RES,FXD,FILM:200K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R470	315-0204-00			RES,FXD,FILM:200K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R472	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R473	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R474	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R475	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R476	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R477	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R478	311-2439-00			RES,VAR,NONWW:TRMR,100 OHM,205,0.5W	80009	311243900
A1R480	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R481	311-2361-00			RES,VAR,NONWW:TRMR,10K OHM,0.5W	K8788	TC10-LV10-10K/A
A1R482	315-0271-00			RES,FXD,FILM:270 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R483	321-0158-00			RES,FXD,FILM:432 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R485	321-0089-00			RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R486	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R487	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R488	321-0155-00			RES,FXD,FILM:402 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R489	311-2352-00			RES,VAR,NONWW:TRMR,220 OHM,0.5W	K8788	TC10-LV 2.5-220
A1R490	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R491	321-0155-00			RES,FXD,FILM:402 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1R492	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R493	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R495	315-0752-00			RES,FXD,FILM:7.5K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R496	315-0752-00			RES,FXD,FILM:7.5K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R497	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R498	321-0158-00			RES,FXD,FILM:432 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R501	321-0322-00			RES,FXD,FILM:22.1K OHM,0.1%,0.125W,TC=T0	19701	5033ED22K10F
A1R502	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
A1R503	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
A1R504	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R505	315-0334-00			RES,FXD,FILM:330K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R506	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R508	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R512	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R514	321-0172-00			RES,FXD,FILM:604 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A1R515	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R516	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R520	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R521	315-0182-00			RES,FXD,FILM:1.8K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R522	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R523	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R524	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R525	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R526	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R530	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R531	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R532	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R533	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R534	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R535	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A1R536	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A1R537	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R538	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R539	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R540	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R541	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R542	321-0274-00			RES,FXD,FILM:6.98K OHM,1%,0.125W,TC=T0	TK1727	2322-151-6K98
A1R543	321-0274-00			RES,FXD,FILM:6.98K OHM,1%,0.125W,TC=T0	TK1727	2322-151-6K98
A1R544	321-0158-00			RES,FXD,FILM:432 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R545	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R546	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R547	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R548	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R549	321-0172-00			RES,FXD,FILM:604 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A1R550	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R551	315-0182-00			RES,FXD,FILM:1.8K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R552	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R553	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R554	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R555	321-0155-00			RES,FXD,FILM:402 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R556	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R557	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R558	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R559	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R560	315-0271-00			RES,FXD,FILM:270 OHM,5%,0.25W	TK1727	SFR25 2322-181-

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1R561	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R562	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R563	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R564	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R565	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R570	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R571	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R572	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R573	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R574	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R575	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R576	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R577	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R579	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R580	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R581	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R582	321-0361-00			RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=T0	19701	5043ED56K20F
A1R583	315-0204-00			RES,FXD,FILM:200K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R584	315-0334-00			RES,FXD,FILM:330K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R585	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R586	315-0334-00			RES,FXD,FILM:330K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R587	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R588	315-0182-00			RES,FXD,FILM:1.8K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R589	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
A1R590	321-0205-00			RES,FXD,FILM:1.33K OHM,1%,0.125W,TC=T0	TK1727	MR25-2322-151-1
A1R600	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R601	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R602	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R603	321-0197-00			RES,FXD,FILM:1.10K OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A1R604	315-0270-00			RES,FXD,FILM:27 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R605	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R606	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R607	315-0561-00			RES,FXD,FILM:560 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R608	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R609	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R610	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R611	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R612	321-0093-00			RES,FXD,FILM:90.9 OHM,1%,0.125W,TC=T0	57668	CRB14 FXE 90.9
A1R613	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A1R614	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A1R653	321-0197-00			RES,FXD,FILM:1.10K OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A1R654	315-0270-00			RES,FXD,FILM:27 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R660	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R661	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R662	321-0093-00			RES,FXD,FILM:90.9 OHM,1%,0.125W,TC=T0	57668	CRB14 FXE 90.9
A1R700	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	TK1727	SFR25 2322-182-
A1R764	315-0821-00			RES,FXD,FILM:820 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R776	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R778	321-0361-00			RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=T0	19701	5043ED56K20F
A1R779	321-0263-00			RES,FXD,FILM:5.36K OHM,1%,0.125W,TC=T0	19701	5043ED5K360F
A1R780	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R781	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R784	323-0310-00			RES,FXD,FILM:16.5K OHM,1%,0.5W,TC=T0	19701	5053RD16K50F
A1R785	315-0243-00			RES,FXD,FILM:24K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R786	321-0182-00			RES,FXD,FILM:768 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-7

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1R787	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R788	321-0205-00			RES,FXD,FILM:1.33K OHM,1%,0.125W,TC=T0	TK1727	MR25-2322-151-1
A1R789	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R790	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R791	321-0158-00			RES,FXD,FILM:432 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R792	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R794	323-0310-00			RES,FXD,FILM:16.5K OHM,1%,0.5W,TC=T0	19701	5053RD16K50F
A1R795	315-0243-00			RES,FXD,FILM:24K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R796	321-0201-00			RES,FXD,FILM:1.21K OHM,1%,0.125W,TC=T0	TK1727	MR252322-151-1K
A1R797	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R798	321-0205-00			RES,FXD,FILM:1.33K OHM,1%,0.125W,TC=T0	TK1727	MR25-2322-151-1
A1R799	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R800	321-0274-00			RES,FXD,FILM:6.98K OHM,1%,0.125W,TC=T0	TK1727	2322-151-6K98
A1R801	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R803	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R804	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R805	315-0562-00			RES,FXD,FILM:5.6K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R806	315-0912-00			RES,FXD,FILM:9.1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R807	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
A1R808	321-0274-00			RES,FXD,FILM:6.98K OHM,1%,0.125W,TC=T0	TK1727	2322-151-6K98
A1R809	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R810	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=T0	19701	5043ED2K050F
A1R811	321-0306-00	202529		RES,FXD,FILM:15.0K OHM,1%,0.125W,TC=T0	19701	5043ED15K00F
A1R812	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R813	315-0163-00			RES,FXD,FILM:16K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R814	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R815	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R816	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
A1R817	315-0562-00			RES,FXD,FILM:5.6K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R818	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R819	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R820	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R821	315-0562-00			RES,FXD,FILM:5.6K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R823	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R824	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R825	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R828	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
A1R832	321-0231-00			RES,FXD,FILM:2.49K OHM,1%,0.125W,TC=T0	19701	5033ED2K49F
A1R834	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R835	321-0231-00			RES,FXD,FILM:2.49K OHM,1%,0.125W,TC=T0	19701	5033ED2K49F
A1R836	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R840	315-0561-00			RES,FXD,FILM:560 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R841	321-0322-00			RES,FXD,FILM:22.1K OHM,0.1%,0.125W,TC=T0	19701	5033ED22K10F
A1R842	315-0241-00			RES,FXD,FILM:240 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R844	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R845	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R846	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A1R849	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R850	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R851	311-2367-00			RES,VAR,NONWW:TRMR,22K OHM,0.5W	K8788	TC10-LV10-22K/A
A1R852	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
A1R853	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R854	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R858	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R860	315-0625-00			RES,FXD,FILM:6.2M OHM,5%,0.25W	TK1727	SFR25 2322-181-

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1R870	311-2358-00			RES,VAR,NONWW:TRMR,100K OHM,0.5W	K8788	TC10-LV10-100K/
A1R871	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A1R872	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R873	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R874	311-2358-00			RES,VAR,NONWW:TRMR,100K OHM,0.5W	K8788	TC10-LV10-100K/
A1R875	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R877	307-0115-00			RES,FXD,CMPSN:7.5 OHM,5%,0.25W	01121	CB75G5 CARD PAC
A1R885	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R886	315-0204-00			RES,FXD,FILM:200K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R888	301-0514-00			RES,FXD,FILM:510K OHM,5%,0.5W	19701	5053CX510K0J
A1R889	301-0514-00			RES,FXD,FILM:510K OHM,5%,0.5W	19701	5053CX510K0J
A1R890	301-0514-00			RES,FXD,FILM:510K OHM,5%,0.5W	19701	5053CX510K0J
A1R891	301-0514-00			RES,FXD,FILM:510K OHM,5%,0.5W	19701	5053CX510K0J
A1R892	301-0514-00			RES,FXD,FILM:510K OHM,5%,0.5W	19701	5053CX510K0J
A1R894	301-0514-00			RES,FXD,FILM:510K OHM,5%,0.5W	19701	5053CX510K0J
A1R898	321-0155-00			RES,FXD,FILM:402 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R899	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R900	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R901	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R907	308-0843-00			RES,FXD,WW:0.2 OHM,5%,1/0W	75042	SP-20, 0.2 OHM
A1R908	321-0337-00			RES,FXD,FILM:31.6K OHM,1%,0.125W,TC=T0	19701	5043ED31K60F
A1R909	315-0162-00			RES,FXD,FILM:1.6K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R910	321-0208-00			RES,FXD,FILM:1.43K OHM,1%,0.125W,TC=T0	19701	5043ED1K43F
A1R911	321-0322-00			RES,FXD,FILM:22.1K OHM,0.1%,0.125W,TC=T0	19701	5033ED22K10F
A1R912	315-0752-00			RES,FXD,FILM:7.5K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R913	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
A1R914	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R915	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R916	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R917	321-0361-00			RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=T0	19701	5043ED56K20F
A1R918	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R919	315-0182-00			RES,FXD,FILM:1.8K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R920	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R921	315-0270-00			RES,FXD,FILM:27 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R922	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R923	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R924	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R925	315-0204-00			RES,FXD,FILM:200K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R926	315-0273-00			RES,FXD,FILM:27K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R927	321-0322-00			RES,FXD,FILM:22.1K OHM,0.1%,0.125W,TC=T0	19701	5033ED22K10F
A1R928	321-0337-00			RES,FXD,FILM:31.6K OHM,1%,0.125W,TC=T0	19701	5043ED31K60F
A1R929	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
A1R930	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R931	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R932	315-0243-00			RES,FXD,FILM:24K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R933	311-2364-00			RES,VAR,NONWW:TRMR,4.7K OHM,0.5W	K8788	TC10-LV10-4K7/A
A1R934	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R935	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R936	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R937	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R938	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R939	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R940	176-0231-00			WIRE,ELECTRICAL:22 AWG,TINNED	K3176	ORDER BY DESCRI
A1R941	321-0253-00			RES,FXD,FILM:4.22K OHM,1%,0.125W,TC=T0	19701	5033ED 4K 220F
A1R942	321-0337-00			RES,FXD,FILM:31.6K OHM,1%,0.125W,TC=T0	19701	5043ED31K60F

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1R943	315-0243-00			RES,FXD,FILM:24K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R944	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R945	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R946	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R952	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R953	321-0097-00	200180		RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R954	315-0185-00			RES,FXD,FILM:1.8M OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R965	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R966	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R967	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R968	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R969	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R976	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R978	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R982	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R983	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A1R993	315-0120-00			RES,FXD,FILM:12 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R1407	321-0361-00			RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=T0	19701	5043ED56K20F
A1R1408	315-0204-00			RES,FXD,FILM:200K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R1409	315-0273-00			RES,FXD,FILM:27K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R1410	321-0361-00			RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=T0	19701	5043ED56K20F
A1R1411	307-1558-00			RESISTOR NETWORK: 33K	80009	307155800
A1R1412	321-0361-00			RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=T0	19701	5043ED56K20F
A1R1414	321-0361-00			RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=T0	19701	5043ED56K20F
A1R1416	321-0361-00			RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=T0	19701	5043ED56K20F
A1R1435	321-0361-00			RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=T0	19701	5043ED56K20F
A1R1437	321-0361-00			RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=T0	19701	5043ED56K20F
A1R1440	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R1441	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R1442	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R1443	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R1444	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A1R1445	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R1460	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R1461	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R1462	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R1463	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R1497	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1R1498	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A1RT236	307-0125-00			RES,THERMAL:500 OHM,10%,NTC	TK1360	C133
A1T902	120-1792-02			TRANSFORMER:HV INVERTER	80009	120179202
A1U130	156-3790-00			MICROCKT,ARR:5L2354CDP	80009	156379000
A1U180	156-3790-00			MICROCKT,ARR:	80009	156379000
A1U225	156-0067-00			IC,LINEAR:BIPOLAR,OP-AMP;;741C,DIP08.3	04713	MC1741CP1
A1U300	156-2988-00			MICROCKT,DGTL:CMOS,QUAD 2 IP NOR	K5856	CD4001BE
A1U304	156-2986-00			MICROCKT,DGTL:CMOS,QUAD 4 IP NOR	K5856	CD4002BE
A1U308	156-2987-00			MICROCKT,DGTL:CMOS,TRIPLE 3 IP NAND	K5856	CD4023BE
A1U310	156-2956-00			MICROCKT,LINEAR:DUAL,INDEP PIFF AMPL	K5856	CA 3054
A1U335	156-2956-00			MICROCKT,LINEAR:DUAL,INDEP PIFF AMPL	K5856	CA 3054
A1U340	156-2956-00			MICROCKT,LINEAR:DUAL,INDEP PIFF AMPL	K5856	CA 3054
A1U370	156-0048-00			MICROCKT,LINEAR:5 XSTR ARRAY	02735	CA3046
A1U380	156-0048-00			MICROCKT,LINEAR:5 XSTR ARRAY	02735	CA3046
A1U415	156-0048-00			MICROCKT,LINEAR:5 XSTR ARRAY	02735	CA3046
A1U425	156-0853-00			IC,LINEAR:BIPOLAR,OP-AMP;DUAL,SINGLE SUPPLY	04713	LM358N
A1U435	156-0048-00			MICROCKT,LINEAR:5 XSTR ARRAY	02735	CA3046

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1U445	156-0048-00			MICROCKT,LINEAR:5 XSTR ARRAY	02735	CA3046
A1U450	156-0853-00			IC,LINEAR:BIPOLAR,OP-AMP;DUAL,SINGLE SUPPLY	04713	LM358N
A1U460	156-2956-00			MICROCKT,LINEAR:DUAL,INDEP PIFF AMPL	K5856	CA 3054
A1U480	156-0205-03			IC,DIGITAL:ECL,GATE;QUAD 2-INPUT OR;10102,D	04713	MC10102P
A1U500	156-1335-00			MICROCKT,DGTL:LSTTL,DUAL RETRIGGERABLE RESE	27014	DM96LS02N
A1U520	156-0205-03			IC,DIGITAL:ECL,GATE;QUAD 2-INPUT OR;10102,D	04713	MC10102P
A1U530	156-1639-00			IC,DIGITAL:ECL,FLIP FLOP;DUAL MASTER-SLAVE;	04713	MC10H131(P OR L
A1U537	156-0721-00			IC,DIGITAL:LSTTL,SCHMITT TRIG;QUAD 2-INPUT	01295	SN74LS132N
A1U540	156-0388-00			IC,DIGITAL:LSTTL,FLIP FLOP;DUAL D-TYPE;74LS	01295	SN74LS74AN
A1U550	156-0205-03			IC,DIGITAL:ECL,GATE;QUAD 2-INPUT OR;10102,D	04713	MC10102P
A1U560	156-0048-00			MICROCKT,LINEAR:5 XSTR ARRAY	02735	CA3046
A1U570	156-1639-00			IC,DIGITAL:ECL,FLIP FLOP;DUAL MASTER-SLAVE;	04713	MC10H131(P OR L
A1U580	156-0853-00			IC,LINEAR:BIPOLAR,OP-AMP;DUAL,SINGLE SUPPLY	04713	LM358N
A1U600	156-0724-02			IC,DIGITAL:LSTTL,GATES;HEX INV, OC;74LS05,D	01295	SN74LS05N3
A1U601	156-2956-00			MICROCKT,LINEAR:DUAL,INDEP PIFF AMPL	K5856	CA 3054
A1U910	156-1627-00			MICROCKT,LINEAR:BIPOLAR,PWM PWR SPLY CONT	01295	TL594CN
A1U920	156-0853-00			IC,LINEAR:BIPOLAR,OP-AMP;DUAL,SINGLE SUPPLY	04713	LM358N
A1U940	156-1627-00			MICROCKT,LINEAR:BIPOLAR,PWM PWR SPLY CONT	01295	TL594CN
A1U975	152-1046-00			SEMICOND DVC,DI:HV MULTR,4KVAC INPUT,12KVAC	U4144	MSL8524
A1U1406	156-0625-00			IC,DIGITAL:CMOS,SHIFT REGISTER;8-BIT PISO;7	27014	MM74C165N
A1U1407	156-0853-00			IC,LINEAR:BIPOLAR,OP-AMP;DUAL,SINGLE SUPPLY	04713	LM358N
A1U1408	156-0625-00			IC,DIGITAL:CMOS,SHIFT REGISTER;8-BIT PISO;7	27014	MM74C165N
A1VR514	152-0166-00			SEMICOND DVC,DI:ZEN,SI,6.2V,5%,400MW,DO-7	04713	SZ11738RL
A1VR776	152-0149-00			DIODE,ZENER:,;10V,5%,0.4W;1N961B,DO-7	04713	1N961B
A1VR792	152-0243-00			SEMICOND DVC,DI:ZEN,SI,15V,5%,0.4W,DO-7	04713	SZ13203 (1N965B
A1VR910	152-0147-00			SEMICOND DVC,DI:ZEN,SI,27V,5%,0.4W,DO-7	04713	SZ50622KRL
A1VR931	152-0317-00			SEMICOND DVC,DI:ZEN,SI,6.2V,5%,0.4W,DO-35	04713	1N825
A1VR939	152-0278-00			DIODE,ZENER:,;3V,5%,0.4W;1N4372A,DO-35 OR 7	04713	1N4372ARL
A1VR942	152-0243-00			SEMICOND DVC,DI:ZEN,SI,15V,5%,0.4W,DO-7	04713	SZ13203 (1N965B
A1VR969	152-0278-00			DIODE,ZENER:,;3V,5%,0.4W;1N4372A,DO-35 OR 7	04713	1N4372ARL
A1VR1441	152-0195-00			DIODE,ZENER:,;5.1V,5%,0.4W;1N751A FMLY,DO-3	04713	SZ11755RL
A1VR1444	152-0195-00			DIODE,ZENER:,;5.1V,5%,0.4W;1N751A FMLY,DO-3	04713	SZ11755RL
A1W30	174-0640-00			CA ASSY,SP,ELEC:4,26 AWG,135MM L,RIBBON	TK0EM	82026-5804(135m
A1W80	174-0640-00			CA ASSY,SP,ELEC:4,26 AWG,135MM L,RIBBON	TK0EM	82026-5804(135m
A1W90	174-1253-00			CA ASSY,SP,ELEC:6,26 AWG,80MM L,RIBBON	TK0EM	ORDER BY DESCRI
A1W100	195-3407-00			LEAD,ELECTRICAL:26 AWG,3.0 L,9-3	TK1544	ORDER BY DESCRI
A1W151	195-3407-00			LEAD,ELECTRICAL:26 AWG,3.0 L,9-3	TK1544	ORDER BY DESCRI
A1W293	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1W590	195-3407-00			LEAD,ELECTRICAL:26 AWG,3.0 L,9-3	TK1544	ORDER BY DESCRI
A1W701	174-1677-00			CA ASSY,SP,ELEC:6 X 350MM,RIBBON	80009	174167700
A1W893	174-0642-00			CA ASSY,SP,ELEC:3,26 AWG,100MM L,RIBBON	TK0EM	82-26-5803(100m
A1W903	174-1250-00			CA ASSY,SP,ELEC:3,26 AWG,110MM L,RIBBON	TK0EM	ORDER BY DESCRI
A1W971	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1W972	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1W984	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1W985	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1W987	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1W989	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1W991	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1W993	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1W995	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1W996	131-0566-00			BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1W1001	174-0638-00			CA ASSY,SP,ELEC:6,26 AWG,165MM L,RIBBON	TK0EM	82-26-5806(165m
A1W1002	174-0638-00			CA ASSY,SP,ELEC:6,26 AWG,165MM L,RIBBON	TK0EM	82-26-5806(165m
A1W1005	174-1254-00			CA ASSY,SP,ELEC:6,26 AWG,135MM L,RIBBON	TK0EM	ORDER BY DESCRI

Component Number	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1W1006	174-0640-00			CA ASSY,SP,ELEC:4,26 AWG,135MM L,RIBBON	TK0EM	82026-5804(135m
A1W1007	174-0640-00			CA ASSY,SP,ELEC:4,26 AWG,135MM L,RIBBON	TK0EM	82026-5804(135m
A1W1008	174-1254-00			CA ASSY,SP,ELEC:6,26 AWG,135MM L,RIBBON	TK0EM	ORDER BY DESCRI
A1W1301	174-1676-00			CA ASSY,SP,ELEC:6 X 350MM,RIBBON	80009	174167600
A1W1303	174-1673-00			CA ASSY,SP,ELEC:4,26 AWG,225MM L,RIBBON	80009	174167300
A1W1304	174-1251-00			CA ASSY,SP,ELEC:4,26 AWG,100MM L,RIBBON	TK0EM	ORDER BY DESCRI
A1W1306	174-1550-00			CA ASSY,SP,ELEC:7.0 L,RIBBON	80009	174155000
A1W1400	174-1251-00			CA ASSY,SP,ELEC:4,26 AWG,100MM L,RIBBON	TK0EM	ORDER BY DESCRI

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A2	671-1604-00			CIRCUIT BD ASSY:A2 ATTENUATOR	80009	671160400
A2AT1	260-2463-00			SWITCH ASSEMBLY:ATTEN,10K VAR	80009	260246300
A2AT51	260-2463-00			SWITCH ASSEMBLY:ATTEN,10K VAR	80009	260246300
A2C6	283-0000-00			CAP,FXD,CER DI:0.001UF,+100-0%,500V	18796	DD07512Y5P102P5
A2C8	281-0812-00			CAP,FXD,CER DI:1000PF,10%,100V	04222	SA101C102KAA
A2C15	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C29	281-0756-00			CAP,FXD,CER DI:2.2PF,+/-0.5PF,200V	04222	SA102A2R2DAA
A2C30	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C31	281-0812-00			CAP,FXD,CER DI:1000PF,10%,100V	04222	SA101C102KAA
A2C32	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	TK1743	CGB103KEX
A2C33	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	TK1743	CGB103KEX
A2C35	281-0812-00			CAP,FXD,CER DI:1000PF,10%,100V	04222	SA101C102KAA
A2C38	281-0812-00			CAP,FXD,CER DI:1000PF,10%,100V	04222	SA101C102KAA
A2C56	283-0000-00			CAP,FXD,CER DI:0.001UF,+100-0%,500V	18796	DD07512Y5P102P5
A2C58	281-0812-00			CAP,FXD,CER DI:1000PF,10%,100V	04222	SA101C102KAA
A2C63	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C79	281-0756-00			CAP,FXD,CER DI:2.2PF,+/-0.5PF,200V	04222	SA102A2R2DAA
A2C80	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C81	281-0812-00			CAP,FXD,CER DI:1000PF,10%,100V	04222	SA101C102KAA
A2C82	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	TK1743	CGB103KEX
A2C83	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	TK1743	CGB103KEX
A2C85	281-0812-00			CAP,FXD,CER DI:1000PF,10%,100V	04222	SA101C102KAA
A2C88	281-0812-00			CAP,FXD,CER DI:1000PF,10%,100V	04222	SA101C102KAA
A2C93	290-1159-00			CAP,FXD,ELCTLT:1000UF,20%,16V	TK0ED	TWSS
A2C94	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C95	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C96	290-1159-00			CAP,FXD,ELCTLT:1000UF,20%,16V	TK0ED	TWSS
A2C97	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C98	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C680	290-1153-00			CAP,FXD,ELCTLT:47UF,+50-10%,10V	K8996	030-24479
A2C684	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C685	290-1159-00			CAP,FXD,ELCTLT:1000UF,20%,16V	TK0ED	TWSS
A2C688	285-1408-00			CAP,FXD,MTLZD:10UF,1%,250V,AXIAL,TUB,MI	TK0ED	ORDER BY DESCRI
A2C691	281-0768-00			CAP,FXD,CER DI:470PF,20%,100V	04222	SA101A471KAA
A2C697	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C698	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C699	281-0756-00			CAP,FXD,CER DI:2.2PF,+/-0.5PF,200V	04222	SA102A2R2DAA
A2C701	285-1409-00			CAP,FXD,MTLZD:1UF,1%,160V,AXIAL,TUB,MI	TK0ED	ORDER BY DESCRI
A2C702	285-1408-00			CAP,FXD,MTLZD:10UF,1%,250V,AXIAL,TUB,MI	TK0ED	ORDER BY DESCRI
A2C703	281-0207-00			CAP,VAR,PLASTIC:2-18PF,100V	K8996	808-11229
A2C704	283-0674-00			CAP,FXD,MICA DI:85PF,1%,500V	TK0891	RDM15FD850F03
A2C705	281-0813-00			CAP,FXD,CER DI:0.047UF,20%,50V	04222	SA105E473MAA
A2C706	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C707	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C708	281-0756-00			CAP,FXD,CER DI:2.2PF,+/-0.5PF,200V	04222	SA102A2R2DAA
A2C709	290-0283-00			CAP,FXD,ELCTLT:0.47UF,10%,35V	31433	T322A474K035AS
A2C712	290-1153-00			CAP,FXD,ELCTLT:47UF,+50-10%,10V	K8996	030-24479
A2C713	290-1153-00			CAP,FXD,ELCTLT:47UF,+50-10%,10V	K8996	030-24479
A2C714	281-0776-00			CAP,FXD,CER DI:120PF,5%,100V	04222	SA102A121JAA
A2C715	290-1153-00			CAP,FXD,ELCTLT:47UF,+50-10%,10V	K8996	030-24479
A2C722	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C723	290-0246-00			CAP,FXD,ELCTLT:3.3UF,10%,15V	12954	D3R3EA15K1
A2C724	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C732	281-0809-00			CAP,FXD,CER DI:200 PF,5%,100V	04222	SA101A201JAA
A2C733	281-0758-00			CAP,FXD,CER DI:15PF,20%,100V	04222	SA102A150MAA

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A2C734	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C745	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C746	281-0809-00			CAP,FXD,CER DI:200 PF,5%,100V	04222	SA101A201JAA
A2C767	281-0786-00			CAP,FXD,CER DI:150PF,10%,100V	04222	SA101A151KAA
A2C774	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2C1400	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A2CR7	152-0324-00			SEMICOND DVC,DI:SW,SI,35V,0.1A,DO-7	14552	MT5128
A2CR18	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A2CR57	152-0324-00			SEMICOND DVC,DI:SW,SI,35V,0.1A,DO-7	14552	MT5128
A2CR68	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A2CR676	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A2CR677	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A2CR678	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A2CR679	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A2CR686	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A2CR732	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A2CR747	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A2CR748	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A2CR755	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A2CR761	152-0322-00			SEMICOND DVC,DI:SCHOTTKY,SI,15V,1.2PF,DO-35	50434	5082-2672
A2CR762	152-0322-00			SEMICOND DVC,DI:SCHOTTKY,SI,15V,1.2PF,DO-35	50434	5082-2672
A2CR769	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A2CR773	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A2CR774	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A2E90	276-0752-00			CORE,EM:FERRITE	TK1442	BP53-BH3.5X10X4
A2E91	276-0752-00			CORE,EM:FERRITE	TK1442	BP53-BH3.5X10X4
A2E92	276-0752-00			CORE,EM:FERRITE	TK1442	BP53-BH3.5X10X4
A2E93	276-0752-00			CORE,EM:FERRITE	TK1442	BP53-BH3.5X10X4
A2J7	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TK0EM	52011-0610
A2J30	204-1033-00			CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TK0EM	52011-0410
A2J80	204-1033-00			CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TK0EM	52011-0410
A2J90	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TK0EM	52011-0610
A2J701	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TK0EM	52011-0610
A2J755	204-1033-00			CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TK0EM	52011-0410
A2J1010	204-1033-00			CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TK0EM	52011-0410
A2J1304	204-1033-00			CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TK0EM	52011-0410
A2J1400	204-1033-00			CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TK0EM	52011-0410
A2L93	120-1631-00			COIL,RF:FXD,210UH	TK00A	ORDER BY DESCRI
A2L96	120-1631-00			COIL,RF:FXD,210UH	TK00A	ORDER BY DESCRI
A2L712	120-1631-00			COIL,RF:FXD,210UH	TK00A	ORDER BY DESCRI
A2L713	120-1631-00			COIL,RF:FXD,210UH	TK00A	ORDER BY DESCRI
A2Q13	151-1235-00			TRANSISTOR:JFET,N-CHAN,DUAL HYBRID	K7068	2N5911
A2Q63	151-1235-00			TRANSISTOR:JFET,N-CHAN,DUAL HYBRID	K7068	2N5911
A2Q680	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A2Q681	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A2Q684	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A2Q690	151-0424-00			TRANSISTOR:NPN,SI,TO-92	07263	S039118
A2Q694	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A2Q698	151-1042-00			TRANSISTOR,SIG:JFET,N-CHANNEL;MATCHED PAIR;	TK1864	SNJ2634
A2Q699	151-0736-00			TRANSISTOR:NPN,SI,TO-92	TK1016	2N4401
A2Q701	151-0424-00			TRANSISTOR:NPN,SI,TO-92	07263	S039118
A2Q702	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A2Q704	151-1042-00			TRANSISTOR,SIG:JFET,N-CHANNEL;MATCHED PAIR;	TK1864	SNJ2634
A2Q706	151-0736-00			TRANSISTOR:NPN,SI,TO-92	TK1016	2N4401
A2Q732	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904

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A2Q737	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A2Q747	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A2Q748	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A2Q750	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A2Q759	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A2Q760	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A2R3	315-0330-00			RES,FXD,FILM:33 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R5	322-0481-01			RES,FXD,FILM:1M OHM, 0.5%,0.25W,TC=T0	03888	PME60 1 M OHM 0
A2R6	315-0474-00			RES,FXD,FILM:470K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R7	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R8	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R9	315-0330-00			RES,FXD,FILM:33 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R13	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R14	315-0200-00			RES,FXD,FILM:20 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R15	315-0200-00			RES,FXD,FILM:20 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R22	321-0210-00			RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=T0	19701	5033ED1K50F
A2R23	321-0210-00			RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=T0	19701	5033ED1K50F
A2R29	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A2R30	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R31	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A2R32	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R33	311-2368-00			RES,VAR,NONWW:TRMR,47K OHM,0.5W	K8788	TC10-LV10-47K/A
A2R35	321-0144-00			RES,FXD,FILM:309 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-3
A2R36	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R37	321-0222-00			RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=T0	19701	5033ED2K00F
A2R38	321-0144-00			RES,FXD,FILM:309 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-3
A2R39	315-0242-00			RES,FXD,FILM:2.4K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R41	321-0154-00			RES,FXD,FILM:392 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-3
A2R42	315-0333-00			RES,FXD,FILM:33K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R53	315-0330-00			RES,FXD,FILM:33 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R55	322-0481-01			RES,FXD,FILM:1M OHM, 0.5%,0.25W,TC=T0	03888	PME60 1 M OHM 0
A2R56	315-0474-00			RES,FXD,FILM:470K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R57	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R58	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R59	315-0330-00			RES,FXD,FILM:33 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R63	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R64	315-0200-00			RES,FXD,FILM:20 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R65	315-0200-00			RES,FXD,FILM:20 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R65	322-0481-00			RES,FXD,FILM:1M OHM,1%,0.25W,TC=T0	03888	PME60 1 M OHM 1
A2R72	321-0210-00			RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=T0	19701	5033ED1K50F
A2R73	321-0210-00			RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=T0	19701	5033ED1K50F
A2R78	321-0222-00			RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=T0	19701	5033ED2K00F
A2R79	321-0068-00			RES,FXD,FILM:49.9 OHM,0.1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A2R80	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R81	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A2R82	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R83	311-2368-00			RES,VAR,NONWW:TRMR,47K OHM,0.5W	K8788	TC10-LV10-47K/A
A2R85	321-0144-00			RES,FXD,FILM:309 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-3
A2R86	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A2R87	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R88	321-0144-00			RES,FXD,FILM:309 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-3
A2R89	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R90	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R91	321-0154-00			RES,FXD,FILM:392 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-3
A2R92	315-0473-00			RES,FXD,FILM:47K OHM,5%,0.25W	TK1727	SFR25 2322-181-

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A2R93	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	TK1727	SFR25 2322-182-
A2R94	315-0333-00			RES,FXD,FILM:33K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R96	307-0113-00			RES,FXD,CMPSN:5.1 OHM,5%,0.25W	01121	CB51G5
A2R655	311-2354-00			RES,VAR,NONWW:TRMR,4.7K OHM,0.5W	K8788	TC10-LH2.5-4K7/
A2R675	315-0201-00			RES,FXD,FILM:200 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R676	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R677	315-0625-00			RES,FXD,FILM:6.2M OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R678	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R679	315-0393-00			RES,FXD,FILM:39K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R680	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R681	315-0433-00			RES,FXD,FILM:43K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R682	315-0243-00			RES,FXD,FILM:24K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R683	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R684	315-0202-00			RES,FXD,FILM:2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R685	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A2R686	315-0473-00			RES,FXD,FILM:47K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R687	311-2368-00			RES,VAR,NONWW:TRMR,47K OHM,0.5W	K8788	TC10-LV10-47K/A
A2R688	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	TK1727	SFR25 2322-182-
A2R689	322-3513-00			RES,FXD,FILM:324K OHM,1%,0.25W	80009	322351300
A2R690	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R691	315-0561-00			RES,FXD,FILM:560 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R693	315-0201-00			RES,FXD,FILM:200 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R694	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R695	315-0562-00			RES,FXD,FILM:5.6K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R696	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
A2R698	315-0151-00			RES,FXD,FILM:150 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R699	321-0274-00			RES,FXD,FILM:6.98K OHM,1%,0.125W,TC=T0	TK1727	2322-151-6K98
A2R700	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	TK1727	SFR25 2322-182-
A2R701	307-0780-01			RES NTWK,FXD,FI:TIMING	80009	307078001
A2R702	322-0519-01			RES,FXD,FILM:2.49M OHM,0.5%,0.25W,TC=T0	03888	PME60 2.49 M OH
A2R703	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	TK1727	SFR25 2322-182-
A2R704	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A2R705	315-0151-00			RES,FXD,FILM:150 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R706	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
A2R707	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R708	315-0201-00			RES,FXD,FILM:200 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R709	315-0562-00			RES,FXD,FILM:5.6K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R711	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R712	321-0231-00			RES,FXD,FILM:2.49K OHM,1%,0.125W,TC=T0	19701	5033ED2K49F
A2R713	321-0231-00			RES,FXD,FILM:2.49K OHM,1%,0.125W,TC=T0	19701	5033ED2K49F
A2R714	321-0235-00			RES,FXD,FILM:2.74K OHM,1%,0.125W,TC=T0	19701	5043ED2K740F
A2R715	321-0231-00			RES,FXD,FILM:2.49K OHM,1%,0.125W,TC=T0	19701	5033ED2K49F
A2R716	321-0225-00			RES,FXD,FILM:2.15K OHM,1%,0.125W,TC=T0	19701	5033ED2K15F
A2R717	321-0306-00			RES,FXD,FILM:15.0K OHM,1%,0.125W,TC=T0	19701	5043ED15K00F
A2R718	321-0306-00			RES,FXD,FILM:15.0K OHM,1%,0.125W,TC=T0	19701	5043ED15K00F
A2R719	315-0330-00			RES,FXD,FILM:33 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R720	315-0201-00			RES,FXD,FILM:200 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R721	311-2423-00			RES,VAR,NONWW:PANEL,470 OHM,20%,0.2W	K8996	ORDER BY DESCRI
A2R722	311-2361-00			RES,VAR,NONWW:TRMR,10K OHM,0.5W	K8788	TC10-LV10-10K/A
A2R723	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R730	311-2353-00			RES,VAR,NONWW:TRMR,470 OHM,0.5W	K8788	311235400
A2R731	311-2422-00			RES,VAR,NONWW:TRMR,100 OHM	K8788	ORDER BY DESCRI
A2R732	321-0251-00			RES,FXD,FILM:4.02K OHM,1%,0.125W,TC=T0	19701	5043ED4K020F
A2R733	321-0231-00			RES,FXD,FILM:2.49K OHM,1%,0.125W,TC=T0	19701	5033ED2K49F
A2R734	315-0272-00			RES,FXD,FILM:2.7K OHM,5%,0.25W	TK1727	SFR25 2322-181-

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A2R735	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R736	311-2421-00			RES,VAR,NONWW:TRMR,1K	K8788	ORDER BY DESCRI
A2R737	321-0197-00			RES,FXD,FILM:1.10K OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A2R738	321-0210-00			RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=T0	19701	5033ED1K50F
A2R739	321-0210-00			RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=T0	19701	5033ED1K50F
A2R740	321-0274-00			RES,FXD,FILM:6.98K OHM,1%,0.125W,TC=T0	TK1727	2322-151-6K98
A2R741	321-0210-00			RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=T0	19701	5033ED1K50F
A2R742	321-0210-00			RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=T0	19701	5033ED1K50F
A2R743	321-0177-00			RES,FXD,FILM:681 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A2R744	321-0177-00			RES,FXD,FILM:681 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A2R745	321-0177-00			RES,FXD,FILM:681 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A2R746	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R747	315-0431-00			RES,FXD,FILM:430 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R748	315-0431-00			RES,FXD,FILM:430 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R749	321-0098-00			RES,FXD,FILM:102 OHM,1%,0.125W,TC=T0	19701	5043ED102R0F
A2R750	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
A2R751	321-0178-00			RES,FXD,FILM:698 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A2R752	321-0178-00			RES,FXD,FILM:698 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A2R753	321-0178-00			RES,FXD,FILM:698 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A2R754	321-0179-00			RES,FXD,FILM:715 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-7
A2R755	315-0132-00			RES,FXD,FILM:1.3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R756	315-0132-00			RES,FXD,FILM:1.3K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R757	321-0172-00			RES,FXD,FILM:604 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A2R759	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R760	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R761	321-0225-00			RES,FXD,FILM:2.15K OHM,1%,0.125W,TC=T0	19701	5033ED2K15F
A2R762	321-0225-00			RES,FXD,FILM:2.15K OHM,1%,0.125W,TC=T0	19701	5033ED2K15F
A2R763	321-0210-00			RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=T0	19701	5033ED1K50F
A2R765	321-0274-00			RES,FXD,FILM:6.98K OHM,1%,0.125W,TC=T0	TK1727	2322-151-6K98
A2R766	321-0274-00			RES,FXD,FILM:6.98K OHM,1%,0.125W,TC=T0	TK1727	2322-151-6K98
A2R767	321-0098-00			RES,FXD,FILM:102 OHM,1%,0.125W,TC=T0	19701	5043ED102R0F
A2R768	321-0285-00			RES,FXD,FILM:9.09K OHM,1%,0.125W,TC=T0	19701	5043ED9K090F
A2R769	315-0162-00			RES,FXD,FILM:1.6K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R770	321-0242-00			RES,FXD,FILM:3.24K OHM,1%,0.125W,TC=T0	TK1727	2322-151-3K24
A2R771	321-0225-00			RES,FXD,FILM:2.15K OHM,1%,0.125W,TC=T0	19701	5033ED2K15F
A2R772	321-0225-00			RES,FXD,FILM:2.15K OHM,1%,0.125W,TC=T0	19701	5033ED2K15F
A2R773	321-0178-00			RES,FXD,FILM:698 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A2R774	321-0178-00			RES,FXD,FILM:698 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A2R775	311-2421-00			RES,VAR,NONWW:TRMR,1K	K8788	ORDER BY DESCRI
A2R777	311-2422-00			RES,VAR,NONWW:TRMR,100 OHM	K8788	ORDER BY DESCRI
A2R782	311-2353-00			RES,VAR,NONWW:TRMR,470 OHM,0.5W	K8788	311235400
A2R1401	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1402	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1403	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1404	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1405	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1420	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1421	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1422	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1423	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1424	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1425	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1426	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1427	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1433	321-0337-00			RES,FXD,FILM:31.6K OHM,1%,0.125W,TC=T0	19701	5043ED31K60F

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A2R1434	315-0163-00			RES,FXD,FILM:16K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1446	321-0337-00			RES,FXD,FILM:31.6K OHM,1%,0.125W,TC=T0	19701	5043ED31K60F
A2R1447	315-0163-00			RES,FXD,FILM:16K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1451	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1452	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1453	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1454	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1455	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1468	321-0337-00			RES,FXD,FILM:31.6K OHM,1%,0.125W,TC=T0	19701	5043ED31K60F
A2R1469	315-0163-00			RES,FXD,FILM:16K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1483	321-0337-00			RES,FXD,FILM:31.6K OHM,1%,0.125W,TC=T0	19701	5043ED31K60F
A2R1484	315-0163-00			RES,FXD,FILM:16K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1489	315-0243-00			RES,FXD,FILM:24K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1490	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1491	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A2R1492	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A2R1493	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A2R1494	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2R1495	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A2S701	260-2451-00			SWITCH,ROTARY:23 POSITION,TIMEBASE	80009	260245100
A2U30	156-0534-00			MICROCKT,LINEAR:DUAL DIFF AMPL	02735	CA3102E-98
A2U80	156-0534-00			MICROCKT,LINEAR:DUAL DIFF AMPL	02735	CA3102E-98
A2U83	156-0048-00			MICROCKT,LINEAR:5 XSTR ARRAY	02735	CA3046
A2U715	156-0067-00			IC,LINEAR:BIPOLAR,OP-AMP;;741C,DIP08.3	04713	MC1741CP1
A2U745	156-0048-00			MICROCKT,LINEAR:5 XSTR ARRAY	02735	CA3046
A2U755	156-0048-00			MICROCKT,LINEAR:5 XSTR ARRAY	02735	CA3046
A2U1400	156-0625-00			IC,DIGITAL:CMOS,SHIFT REGISTER;8-BIT PISO;7	27014	MM74C165N
A2U1402	156-0625-00			IC,DIGITAL:CMOS,SHIFT REGISTER;8-BIT PISO;7	27014	MM74C165N
A2U1404	156-0625-00			IC,DIGITAL:CMOS,SHIFT REGISTER;8-BIT PISO;7	27014	MM74C165N
A2VR719	152-0744-00			SEMICOND DVC,DI:ZEN,SI,3.6V,5%,0.4W,DO-7	04713	SZC30619RL (1N7
A2W1010	174-1251-00			CA ASSY,SP,ELEC:4,26 AWG,100MM L,RIBBON	TK0EM	ORDER BY DESCRI
A2W1401	174-0635-00			CA ASSY,SP,ELEC:6,26 AWG,120MM L,RIBBON	TK0EM	82-26-5806(120m
A2W1451	174-0635-00			CA ASSY,SP,ELEC:6,26 AWG,120MM L,RIBBON	TK0EM	82-26-5806(120m

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A3	671-1605-00			CIRCUIT BD ASSY:A3 FRONT PANEL	80009	671160500
A3C2	285-1106-00			CAP,FXD,PLASTIC:0.022UF,20%,600V	14752	230B1F223
A3C45	290-1153-00			CAP,FXD,ELCTLT:47UF,+50-10%,10V	K8996	030-24479
A3C46	290-1153-00			CAP,FXD,ELCTLT:47UF,+50-10%,10V	K8996	030-24479
A3C52	285-1106-00			CAP,FXD,PLASTIC:0.022UF,20%,600V	14752	230B1F223
A3C104	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A3C204	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A3C373	285-1385-00			CAP,FXD,PLASTIC:43PF,2.5%,630V	K7779	B31063-A6430-H6
A3C376	285-1387-00			CAP,FXD,PLASTIC:0.01UF,10%,400V	TK0DZ	MKT1-50
A3C377	285-1427-00			CAP,FXD,PLASTIC:33PF,+/-PF,630V	80009	285142700
A3C378	281-0767-00			CAP,FXD,CER DI:330PF,20%,100V	04222	SA102C331MAA
A3C383	285-1385-00			CAP,FXD,PLASTIC:43PF,2.5%,630V	K7779	B31063-A6430-H6
A3C392	281-0815-00			CAP,FXD,CER DI:0.027UF,20%,50V	04222	SA205C273MAA
A3C402	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A3C403	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A3C725	290-1153-00			CAP,FXD,ELCTLT:47UF,+50-10%,10V	K8996	030-24479
A3C726	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A3CR381	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A3CR534	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A3CR537	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A3CR538	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A3DS370	150-1187-00			LT EMITTING DIO:GREEN	TK00A	LN31GPHL/EXLED5
A3DS560	150-1187-00			LT EMITTING DIO:GREEN	TK00A	LN31GPHL/EXLED5
A3Q370	151-1042-00			TRANSISTOR,SIG:JFET,N-CHANNEL;MATCHED PAIR;	TK1864	SNJ2634
A3Q725	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A3R1	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A3R2	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25W	TK1727	SFR25 2322-181-
A3R4	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	TK1727	SFR25 2322-182-
A3R45	307-0113-00			RES,FXD,CMPSN:5.1 OHM,5%,0.25W	01121	CB51G5
A3R46	307-0113-00			RES,FXD,CMPSN:5.1 OHM,5%,0.25W	01121	CB51G5
A3R51	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A3R52	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25W	TK1727	SFR25 2322-181-
A3R54	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	TK1727	SFR25 2322-182-
A3R84	311-2368-00			RES,VAR,NONWW:TRMR,47K OHM,0.5W	K8788	TC10-LV10-47K/A
A3R113	321-0251-00			RES,FXD,FILM:4.02K OHM,1%,0.125W,TC=T0	19701	5043ED4K020F
A3R123	311-2366-00			RES,VAR,NONWW:PNL,470 OHM,20%,0.2W	K8996	PP17/000HFAQA23
A3R163	321-0251-00			RES,FXD,FILM:4.02K OHM,1%,0.125W,TC=T0	19701	5043ED4K020F
A3R173	311-2366-00			RES,VAR,NONWW:PNL,470 OHM,20%,0.2W	K8996	PP17/000HFAQA23
A3R278	321-0231-00			RES,FXD,FILM:2.49K OHM,1%,0.125W,TC=T0	19701	5033ED2K49F
A3R280	311-2362-00			RES,VAR,NONWW:PNL,4.7K OHM,20%,0.2W	K8996	PP17/000HFAOA36
A3R365	321-0172-00			RES,FXD,FILM:604 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A3R370	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A3R371	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A3R372	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A3R373	315-0202-00			RES,FXD,FILM:2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A3R376	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A3R377	315-0434-00			RES,FXD,FILM:430K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A3R378	315-0393-00			RES,FXD,FILM:39K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A3R379	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A3R382	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A3R383	315-0564-00			RES,FXD,FILM:560K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A3R511	311-2360-00			RES,VAR,NONWW:PNL,47K OHM,20%,0.2W	K8996	PP17/000HFAOA49
A3R517	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A3R518	315-0912-00			RES,FXD,FILM:9.1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A3R724	315-0751-00			RES,FXD,FILM:750 OHM,5%,0.25W	TK1727	SFR25 2322-181-

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A3R725	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A3R726	311-2366-00			RES,VAR,NONWW:PNL,470 OHM,20%,0.2W	K8996	PP17/000HFAQA23
A3R727	321-0177-00			RES,FXD,FILM:681 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A3R728	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
A3R729	311-2362-00			RES,VAR,NONWW:PNL,4.7K OHM,20%,0.2W	K8996	PP17/000HFAOA36
A3R986	311-2364-00			RES,VAR,NONWW:TRMR,4.7K OHM,0.5W	K8788	TC10-LV10-4K7/A
A3R987	315-0201-00			RES,FXD,FILM:200 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A3S90	260-2291-00			SWITCH,SLIDE:DPDT,250MA,100VAC	U3771	607/TK 2 POS
A3S101	260-2293-00			SWITCH,SLIDE:DPDT,250MA,100VAC	U3771	607/TEK 3 POS
A3S201	260-2293-00			SWITCH,SLIDE:DPDT,250MA,100VAC	U3771	607/TEK 3 POS
A3S380	260-2292-00			SWITCH,SLIDE:DPDT,250MA,100VAC	U3771	607/TEK 4 POS
A3S390	260-2290-00			SWITCH,PUSH:1 BUTTON,1 POLE,MOMENTARY	TK0EA	SKECCAA061A
A3S392	260-2292-00			SWITCH,SLIDE:DPDT,250MA,100VAC	U3771	607/TEK 4 POS
A3S401	260-2292-00			SWITCH,SLIDE:DPDT,250MA,100VAC	U3771	607/TEK 4 POS
A3S460	260-2291-00			SWITCH,SLIDE:DPDT,250MA,100VAC	U3771	607/TK 2 POS
A3S505	260-2290-00			SWITCH,PUSH:1 BUTTON,1 POLE,MOMENTARY	TK0EA	SKECCAA061A
A3S545	260-2293-00			SWITCH,SLIDE:DPDT,250MA,100VAC	U3771	607/TEK 3 POS
A3S550	260-2293-00			SWITCH,SLIDE:DPDT,250MA,100VAC	U3771	607/TEK 3 POS
A3S555	260-2292-00			SWITCH,SLIDE:DPDT,250MA,100VAC	U3771	607/TEK 4 POS
A3S603	260-2293-00			SWITCH,SLIDE:DPDT,250MA,100VAC	U3771	607/TEK 3 POS
A3W1	174-1675-00			CA ASSY,SP,ELEC:6 X 215MML,RIBBON	80009	174167500
A3W2	174-0639-00			CA ASSY,SP,ELEC:6,26 AWG,110MM L,RIBBON	TK0EM	82026-5806(95mm
A3W3	174-1675-00			CA ASSY,SP,ELEC:6 X 215MML,RIBBON	80009	174167500
A3W4	174-0639-00			CA ASSY,SP,ELEC:6,26 AWG,110MM L,RIBBON	TK0EM	82026-5806(95mm
A3W5	174-1675-00			CA ASSY,SP,ELEC:6 X 215MML,RIBBON	80009	174167500
A3W6	174-0639-00			CA ASSY,SP,ELEC:6,26 AWG,110MM L,RIBBON	TK0EM	82026-5806(95mm
A3W7	174-1256-00			CA ASSY,SP,ELEC:6,26 AWG,180MM L,RIBBON	TK0EM	ORDER BY DESCRI

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A4	671-1606-00			CIRCUIT BD ASSY:A4 POWER	80009	671160600
A4C900	290-1158-00			CAP,FXD,ELCTLT:2200UF,20%,80V	TK0ED	ORDER BY DESCRI
A4C903	285-1192-00			CAP,FXD,PPR DI:0.0022 UF,20%,250VAC	TK0515	PME271Y422
A4C904	285-1192-00			CAP,FXD,PPR DI:0.0022 UF,20%,250VAC	TK0515	PME271Y422
A4C905	285-1252-00			CAP,FXD,PLASTIC:0.15UF,10%,250VAC	D5243	F1772-415-2000
A4CR901	152-1098-00			SEMICOND DVC,DI:POWER RECTIFIER	80009	152109800
A4CR902	152-1098-00			SEMICOND DVC,DI:POWER RECTIFIER	80009	152109800
A4CR903	152-1098-00			SEMICOND DVC,DI:POWER RECTIFIER	80009	152109800
A4CR904	152-1098-00			SEMICOND DVC,DI:POWER RECTIFIER	80009	152109800
A4FS901	159-0032-00			FUSE,CARTRIDGE:3AG,0.5A,250V,SLOW BLOW	71400	MDL 1/2
A4J901	131-3905-00			CONN,RCPT,ELEC:PWR,250VAC,6A,CKT BD MT	TK0DY	L2157
A4J902	204-1038-00			CONN BODY,PLUG:1 X 8 W/O LOCKING EARS	80009	204103800
A4L901	108-1375-00			COIL,RF:FXD,82UH,1A	TK00A	RL-1218-820K-1A
A4L902	108-1375-00			COIL,RF:FXD,82UH,1A	TK00A	RL-1218-820K-1A
A4Q900	151-0350-00			TRANSISTOR:PNP,SI,TO-92	TK1016	TO BE ASSIGNED
A4R902	315-0473-00			RES,FXD,FILM:47K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A4R903	315-0243-00			RES,FXD,FILM:24K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A4R904	315-0562-00			RES,FXD,FILM:5.6K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A4R905	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A4R906	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25W	TK1727	SFR25 2322-181-
A4S901	260-1849-05			SWITCH,PUSH:DPDT,4A,250VAC,W/BRACKET	31918	NE-15 SERIES
A4S902	260-2116-00			SWITCH,SLIDE:DPDT,10A,125VAC,LINE SEL	04426	18-000-0019

Component Number	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A5	671-1607-00			CIRCUIT BD ASSY:A5 FOCUS	80009	671160700
A5R893	311-2444-00			RES,VAR,NONWW:TRMR,2.2,30%,0.25W,PLASTIC SI	80009	311244400
A5W893				(NOT REPLACEABLE - ORDER A5)		

Component Number	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A6	671–1608–00			CIRCUIT BD ASSY:A6 CURSOR	80009	671160800
A6R1308	307–1524–00			RES,VAR,NONWW:10K DUAL,10K MONENTARY SW	80009	307152400

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A7	671-1609-00			CIRCUIT BD ASSY:A7 INTENSITY	80009	671160900
A7R802	311-2177-04			RES,VAR,NONWW:PNL,10K OHM,20%,0.5W	12697	CM45252

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A8	671-1878-00			CIRCUIT BD ASSY:TRANSISTOR	80009	671187800
A8E106	276-0752-00			CORE,EM:FERRITE	TK1442	BP53-BH3.5X10X4
A8E107	276-0752-00			CORE,EM:FERRITE	TK1442	BP53-BH3.5X10X4
A8E156	276-0752-00			CORE,EM:FERRITE	TK1442	BP53-BH3.5X10X4
A8E157	276-0752-00			CORE,EM:FERRITE	TK1442	BP53-BH3.5X10X4
A8Q106	151-0711-00			TRANSISTOR:NPN,SI,TO-92B	04713	SPS8224 (MPSH10
A8Q107	151-0711-00			TRANSISTOR:NPN,SI,TO-92B	04713	SPS8224 (MPSH10
A8Q156	151-0711-00			TRANSISTOR:NPN,SI,TO-92B	04713	SPS8224 (MPSH10
A8Q157	151-0711-00			TRANSISTOR:NPN,SI,TO-92B	04713	SPS8224 (MPSH10

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A10	671-1610-00			CIRCUIT BD ASSY:A10 STORAGE	80009	671161000
A10C1001	290-1153-00			CAP,FXD,ELCTLT:47UF,+50-10%,10V	K8996	030-24479
A10C1002	290-1153-00			CAP,FXD,ELCTLT:47UF,+50-10%,10V	K8996	030-24479
A10C1003	281-0104-00			CAP ASSEMBLY:1.0PF & 0.2-1.5PF	72982	293900618A0109C
A10C1004	281-0104-00			CAP ASSEMBLY:1.0PF & 0.2-1.5PF	72982	293900618A0109C
A10C1005	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1006	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1011	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1034	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1101	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1102	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1103	290-1150-00			CAP,FXD,ELCTLT:15UF,+50%-10%,16WVDC	K8996	030-25159
A10C1104	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1105	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1106	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1107	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1108	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1109	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1110	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1111	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1112	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1130	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1500	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1502	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1503	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1506	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1507	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1508	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1509	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1511	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1512	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1513	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1514	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1515	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1516	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1519	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1520	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1521	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1524	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1545	283-0999-00			CAP,FXD,CER DI:0.02UF,+100/-25%,50V	80009	283099900
A10C1556	283-1040-00			CAP,FXD,CER DI:0.07PF,50V	80009	283104000
A10C1557	283-1040-00			CAP,FXD,CER DI:0.07PF,50V	80009	283104000
A10C1579	283-0988-00			CAP,FXD,CER DI:0.33UF,10%,160V	TK0GW	MKP1840-433-165
A10C1580	283-0988-00			CAP,FXD,CER DI:0.33UF,10%,160V	TK0GW	MKP1840-433-165
A10C1581	283-0988-00			CAP,FXD,CER DI:0.33UF,10%,160V	TK0GW	MKP1840-433-165
A10C1582	283-0988-00			CAP,FXD,CER DI:0.33UF,10%,160V	TK0GW	MKP1840-433-165
A10C1583	283-0988-00			CAP,FXD,CER DI:0.33UF,10%,160V	TK0GW	MKP1840-433-165
A10C1584	283-0988-00			CAP,FXD,CER DI:0.33UF,10%,160V	TK0GW	MKP1840-433-165
A10C1592	283-0988-00			CAP,FXD,CER DI:0.33UF,10%,160V	TK0GW	MKP1840-433-165
A10C1600	283-1039-00			CAP,FXD,CER DI:0.03PF,50V	80009	283103900
A10C1604	283-1039-00			CAP,FXD,CER DI:0.03PF,50V	80009	283103900
A10C1605	283-1039-00			CAP,FXD,CER DI:0.03PF,50V	80009	283103900
A10C1751	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1752	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1753	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A10C1754	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1755	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1757	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1759	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1760	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1761	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1762	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1764	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1765	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1766	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1767	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1781	283-0999-00			CAP,FXD,CER DI:0.02UF,+100/-25%,50V	80009	283099900
A10C1796	283-0999-00			CAP,FXD,CER DI:0.02UF,+100/-25%,50V	80009	283099900
A10C1797	283-0999-00			CAP,FXD,CER DI:0.02UF,+100/-25%,50V	80009	283099900
A10C1799	283-0999-00			CAP,FXD,CER DI:0.02UF,+100/-25%,50V	80009	283099900
A10C1853	283-0994-00			CAP,FXD:0.022UF,10%,500V,MLCC	29454	501S41W223KV4E-
A10C1854	283-0994-00			CAP,FXD:0.022UF,10%,500V,MLCC	29454	501S41W223KV4E-
A10C1861	283-0994-00			CAP,FXD:0.022UF,10%,500V,MLCC	29454	501S41W223KV4E-
A10C1862	281-0775-00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1863	283-0994-00			CAP,FXD:0.022UF,10%,500V,MLCC	29454	501S41W223KV4E-
A10C2001	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C2002	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C2003	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C2007	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C2008	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C2101	283-0994-00			CAP,FXD:0.022UF,10%,500V,MLCC	29454	501S41W223KV4E-
A10C2105	283-1040-00			CAP,FXD,CER DI:0.07PF,50V	80009	283104000
A10C2106	283-1040-00			CAP,FXD,CER DI:0.07PF,50V	80009	283104000
A10C2108	283-1039-00			CAP,FXD,CER DI:0.03PF,50V	80009	283103900
A10C2250	281-0815-00			CAP,FXD,CER DI:0.027UF,20%,50V	04222	SA205C273MAA
A10C2251	281-0815-00			CAP,FXD,CER DI:0.027UF,20%,50V	04222	SA205C273MAA
A10C2252	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C2253	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C2254	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C2255	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C2256	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C2258	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C2259	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C2261	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C2262	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C2359	283-0994-00			CAP,FXD:0.022UF,10%,500V,MLCC	29454	501S41W223KV4E-
A10C2361	283-0994-00			CAP,FXD:0.022UF,10%,500V,MLCC	29454	501S41W223KV4E-
A10C2362	283-0994-00			CAP,FXD:0.022UF,10%,500V,MLCC	29454	501S41W223KV4E-
A10C3002	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C3005	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C3006	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C3105	283-0999-00			CAP,FXD,CER DI:0.02UF,+100/-25%,50V	80009	283099900
A10C3201	290-0246-00			CAP,FXD,ELCTLT:3.3UF,10%,15V	12954	D3R3EA15K1
A10C3202	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C3203	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C3204	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7000	283-0988-00			CAP,FXD,CER DI:0.33UF,10%,160V	TK0GW	MKP1840-433-165
A10C7001	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7002	281-0814-00			CAP,FXD,CER DI:100 PF,10%,100V	TK1743	CGB101KEN
A10C7003	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA

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A10C7005	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7006	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7007	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7008	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7009	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7010	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7011	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7012	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7013	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7014	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7015	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7016	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7017	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7018	290-1153-00			CAP,FXD,ELCTLT:47UF,+50-10%,10V	K8996	030-24479
A10C7020	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7021	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7066	290-1153-00			CAP,FXD,ELCTLT:47UF,+50-10%,10V	K8996	030-24479
A10C7101	283-0999-00			CAP,FXD,CER DI:0.02UF,+100/-25%,50V	80009	283099900
A10C7106	283-0988-00			CAP,FXD,CER DI:0.33UF,10%,160V	TK0GW	MKP1840-433-165
A10C7107	283-0988-00			CAP,FXD,CER DI:0.33UF,10%,160V	TK0GW	MKP1840-433-165
A10C7108	283-0999-00			CAP,FXD,CER DI:0.02UF,+100/-25%,50V	80009	283099900
A10C7117	283-0999-00			CAP,FXD,CER DI:0.02UF,+100/-25%,50V	80009	283099900
A10C7121	283-0999-00			CAP,FXD,CER DI:0.02UF,+100/-25%,50V	80009	283099900
A10C7501	281-0865-00			CAP,FXD,CER DI:1000PF,5%,100V	04222	SA201A102JAA
A10C7502	281-0893-00			CAP,FXD,CER DI:4.7PF,+/-0.5PF,100V	04222	SA101A4R7DAA
A10C7503	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7504	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C8001	290-0246-00			CAP,FXD,ELCTLT:3.3UF,10%,15V	12954	D3R3EA15K1
A10CR1001	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR1002	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR1003	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR1004	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR1005	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR1006	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR1007	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR1008	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR1009	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR1010	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR1011	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR1012	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR1013	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR1014	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR1015	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR1017	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR1018	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR1501	152-1055-00			SEMICOND DVC,DI:SCHOTTKY,40V,0.5 AMP	TK0EN	MBR-040
A10CR1502	152-1055-00			SEMICOND DVC,DI:SCHOTTKY,40V,0.5 AMP	TK0EN	MBR-040
A10CR1503	152-1055-00			SEMICOND DVC,DI:SCHOTTKY,40V,0.5 AMP	TK0EN	MBR-040
A10CR1504	152-1055-00			SEMICOND DVC,DI:SCHOTTKY,40V,0.5 AMP	TK0EN	MBR-040
A10CR3200	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR7501	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10CR7502	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A10J1001	204-1033-00			CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TK0EM	52011-0410
A10J1002	204-1033-00			CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TK0EM	52011-0410
A10J1005	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TK0EM	52011-0610

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A10J1006	204-1033-00			CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TK0EM	52011-0410
A10J1007	204-1033-00			CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TK0EM	52011-0410
A10J1008	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TK0EM	52011-0610
A10J1009	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TK0EM	52011-0610
A10J1010	204-1033-00			CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TK0EM	52011-0410
A10J1292	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TK0EM	52011-0610
A10J1302	136-0756-00			SKT,PL-IN ELEK:MICROCIRCUIT,18 DIP	09922	DILB18P-108
A10J1303	204-1033-00			CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TK0EM	52011-0410
A10L1001	120-1631-00			COIL,RF:FXD,210UH	TK00A	ORDER BY DESCRI
A10Q1001	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A10Q1002	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A10Q1003	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A10Q1004	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A10Q1005	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A10Q1006	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A10Q1007	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A10Q1008	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A10Q1009	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A10Q1010	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A10Q1011	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A10Q1012	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A10Q1013	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A10Q1014	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A10Q1101	151-0190-00			TRANSISTOR:NPN,SI,TO-92	07263	2N3904
A10Q1102	151-0188-00			TRANSISTOR:PNP,SI,TO-92	04713	2N3906
A10Q7503	151-1042-00			TRANSISTOR,SIG:JFET,N-CHANNEL;MATCHED PAIR;	TK1864	SNJ2634
A10R1001	311-2422-00			RES,VAR,NONWW:TRMR,100 OHM	K8788	ORDER BY DESCRI
A10R1002	321-0069-00			RES,FXD,FILM:51.1 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A10R1003	321-0069-00			RES,FXD,FILM:51.1 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A10R1004	311-2422-00			RES,VAR,NONWW:TRMR,100 OHM	K8788	ORDER BY DESCRI
A10R1005	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A10R1006	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A10R1007	321-0069-00			RES,FXD,FILM:51.1 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A10R1008	321-0069-00			RES,FXD,FILM:51.1 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A10R1009	321-0069-00			RES,FXD,FILM:51.1 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A10R1010	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A10R1011	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A10R1012	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A10R1013	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A10R1014	321-0069-00			RES,FXD,FILM:51.1 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A10R1015	321-0170-00			RES,FXD,FILM:576 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-5
A10R1016	311-2435-00			RES,VAR,NONWW:TRMR,220 OHM,0.5W	K8788	TC10LH2.5-220R/
A10R1017	311-2352-00			RES,VAR,NONWW:TRMR,220 OHM,0.5W	K8788	TC10-LV 2.5-220
A10R1018	321-0170-00			RES,FXD,FILM:576 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-5
A10R1019	321-0193-00			RES,FXD,FILM:1K OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A10R1020	321-0193-00			RES,FXD,FILM:1K OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A10R1021	321-0193-00			RES,FXD,FILM:1K OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A10R1022	321-0193-00			RES,FXD,FILM:1K OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A10R1023	321-0193-00			RES,FXD,FILM:1K OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A10R1024	321-0193-00			RES,FXD,FILM:1K OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A10R1025	321-0128-00			RES,FXD,FILM:210 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-2
A10R1026	321-0097-00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A10R1027	321-0199-00			RES,FXD,FILM:1.15K OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A10R1028	321-0199-00			RES,FXD,FILM:1.15K OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A10R1029	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W	TK1727	SFR25 2322-181-

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A10R1030	315-0362-00			RES,FXD,FILM:3.6K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1031	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1032	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1033	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1034	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1036	311-2420-00			RES,VAR,NONWW:TRMR,10K	K8788	ORDER BY DESCRI
A10R1037	321-0222-00			RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=T0	19701	5033ED2K00F
A10R1038	321-0069-00			RES,FXD,FILM:51.1 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A10R1039	321-0069-00			RES,FXD,FILM:51.1 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A10R1040	311-2422-00			RES,VAR,NONWW:TRMR,100 OHM	K8788	ORDER BY DESCRI
A10R1041	321-0069-00			RES,FXD,FILM:51.1 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-9
A10R1102	321-0289-00			RES,FXD,FILM:10.0K OHM,1%,0.125W,TC=T0	19701	5043ED10K00F
A10R1104	321-0222-00			RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=T0	19701	5033ED2K00F
A10R1105	321-0222-00			RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=T0	19701	5033ED2K00F
A10R1106	321-0222-00			RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=T0	19701	5033ED2K00F
A10R1107	315-0151-00			RES,FXD,FILM:150 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1130	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1501	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1502	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1504	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1505	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1506	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1507	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1508	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1509	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1510	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1513	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1514	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1515	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1516	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1517	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1519	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1520	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1521	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1749	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1750	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1751	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1752	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1753	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1755	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1756	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1757	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1758	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1759	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R1760	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2001	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2002	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2003	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2004	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2005	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2006	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2010	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2011	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2012	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2013	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	TK1727	SFR25 2322-181-

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A10R2014	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2015	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2016	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2017	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2200	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2250	321-0361-00			RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=T0	19701	5043ED56K20F
A10R2251	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2252	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2253	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2254	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2255	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2256	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2257	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2258	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2259	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2260	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2261	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R2262	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R3001	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R3201	315-0134-00			RES,FXD,FILM:130K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R3203	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R3205	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R7001	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R7002	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R7003	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R7004	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R7009	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R7010	315-0680-00			RES,FXD,FILM:68 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R7011	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R7012	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R7013	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R7014	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R7015	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R7016	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R7017	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R7018	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R7500	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R7501	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R7502	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10R7503	315-0151-00			RES,FXD,FILM:150 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A10RP1500	307-1476-00			RES NTWK,FXD,FI:1 K OHM X 8,1%,0.125W	TK0FX	ORDER BY DESCRI
A10RP1501	307-1476-00			RES NTWK,FXD,FI:1 K OHM X 8,1%,0.125W	TK0FX	ORDER BY DESCRI
A10RP1502	307-1476-00			RES NTWK,FXD,FI:1 K OHM X 8,1%,0.125W	TK0FX	ORDER BY DESCRI
A10RP1503	307-1476-00			RES NTWK,FXD,FI:1 K OHM X 8,1%,0.125W	TK0FX	ORDER BY DESCRI
A10RP2200	307-1477-00			RES NTWK,FXD,FI:10K OHM X 8,1%,0.125W	TK0FX	ORDER BY DESCRI
A10SW3001	260-2241-00			SWITCH,ROCKER:SPDT,5A,120VAC	09353	7101-J1-Z-B BLA
A10U1101	156-0991-00			MICROCKT,LINEAR:VOLTAGE REGULATOR	04713	MC78L05ACP
A10U1102	156-0158-00			IC,LINEAR:BIPOLAR,OP-AMP;DUAL;MC1458P1,DIP0	04713	MC1458P1
A10U1103	156-2800-00			MICROCKT,INTFC:BIPOLAR,A/D CONVERTER,8 BIT	04713	MC10319 (P OR L
A10U1104	156-2800-00			MICROCKT,INTFC:BIPOLAR,A/D CONVERTER,8 BIT	04713	MC10319 (P OR L
A10U1500	156-1704-01			IC,DIGITAL:FTTL,FLIP FLOP;OCTAL D-TYPE, 3-S	18324	N74F374NB
A10U1501	156-2369-00			IC,DIGITAL:HCTCMOS,BUFFER/DRIVER;OCTAL, DRI	01295	SN74HCT541 (N3
A10U1502	156-2256-00			IC,DIGITAL:HCMOS,GATES;QUAD 2-INPUT NAND;74	01295	SN74HC00N3/J4
A10U1503	156-3069-00			IC,DIGITAL:HCMOS,FLIP FLOP;OCTAL D-TYPE, NO	01295	SN74HC574N
A10U1504	156-2063-00			IC,DIGITAL:ALSTTL,FLIP FLOP;OCTAL D-TYPE, N	01295	SN74ALS374N

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A10U1505	156-2063-00			IC,DIGITAL:ALSTTL,FLIP FLOP;OCTAL D-TYPE, N	01295	SN74ALS374N
A10U1506	156-3492-00			IC,MEMORY:CMOS,SRAM;,45NS	TK0EN	MCM6264C45
A10U1507	156-3492-00			IC,MEMORY:CMOS,SRAM;,45NS	TK0EN	MCM6264C45
A10U1508	156-2369-00			IC,DIGITAL:HCTCMOS,BUFFER/DRIVER;OCTAL, DRI	01295	SN74HCT541 (N3
A10U1509	156-2251-00			IC,DIGITAL:FTTL,COUNTER;SYNCH 4-BIT BINARY;	04713	MC74F161AN
A10U1510	156-2251-00			IC,DIGITAL:FTTL,COUNTER;SYNCH 4-BIT BINARY;	04713	MC74F161AN
A10U1511	156-2251-00			IC,DIGITAL:FTTL,COUNTER;SYNCH 4-BIT BINARY;	04713	MC74F161AN
A10U1512	156-2251-00			IC,DIGITAL:FTTL,COUNTER;SYNCH 4-BIT BINARY;	04713	MC74F161AN
A10U1513	156-2251-00			IC,DIGITAL:FTTL,COUNTER;SYNCH 4-BIT BINARY;	04713	MC74F161AN
A10U1514	156-2251-00			IC,DIGITAL:FTTL,COUNTER;SYNCH 4-BIT BINARY;	04713	MC74F161AN
A10U1515	156-2685-00			IC,DGTL:HCMOS,GATE;QUAD 2-INPUT NAND, OPEN	18324	74HC03N
A10U1516	156-2357-00			IC,DIGITAL:HCTCMOS,FLIP FLOP;OCTAL D-TYPE,	01295	SN74HCT574N
A10U1517	156-2357-00			IC,DIGITAL:HCTCMOS,FLIP FLOP;OCTAL D-TYPE,	01295	SN74HCT574N
A10U1518	156-2357-00			IC,DIGITAL:HCTCMOS,FLIP FLOP;OCTAL D-TYPE,	01295	SN74HCT574N
A10U1519	156-2357-00			IC,DIGITAL:HCTCMOS,FLIP FLOP;OCTAL D-TYPE,	01295	SN74HCT574N
A10U1520	156-2581-00			IC,DIGITAL:HCCMOS,MUX;DUAL 4-TO-1 DATA SELE	27014	MM74HC153N
A10U1521	156-1723-00			IC,DIGITAL:FTTL,GATE;QUAD 2-INPUT AND;74F08	04713	MC74F08N
A10U1522	156-1973-00			IC,DIGITAL:FTTL,FLIP FLOP;QUAD D-TYPE, CLEA	18324	N74F175N
A10U1524	156-1707-00			IC,DIGITAL:FTTL,GATES;QUAD 2-INPUT NAND;74F	04713	MC74F00 (N OR J
A10U1750	156-1723-00			IC,DIGITAL:FTTL,GATE;QUAD 2-INPUT AND;74F08	04713	MC74F08N
A10U1751	156-1611-00			IC,DIGITAL:FTTL,FLIP FLOP;DUAL D-TYPE;74F74	04713	MC74F74N
A10U1752	156-2009-00			IC,DIGITAL:HCCMOS,FLIP FLOP;DUAL D-TYPE;74H	04713	MC74HC74AN
A10U1753	160-5368-00			MICROCKT,DGTL:LOGIC ARRAY,PRGM	TK0GA	PAL C22V10-25PG
A10U1754	160-5378-00			MICROCKT,DGTL:LOGIC ARRAY,PRGM	TK0GA	PAL 22V10-25
A10U1755	156-1751-00			IC,DIGITAL:FTTL,GATES;4-2-3-2 INPUT AND-OR-	04713	MC74F64N
A10U1756	156-1751-00			IC,DIGITAL:FTTL,GATES;4-2-3-2 INPUT AND-OR-	04713	MC74F64N
A10U1757	156-1611-00			IC,DIGITAL:FTTL,FLIP FLOP;DUAL D-TYPE;74F74	04713	MC74F74N
A10U1759	156-1973-00			IC,DIGITAL:FTTL,FLIP FLOP;QUAD D-TYPE, CLEA	18324	N74F175N
A10U1761	160-6050-00			MICROCKT,DGTL:LOGIC ARRAY,PRGM	80009	160605000
A10U1762	160-6051-00			MICROCKT,DGTL:LOGIC ARRAY,PRGM	80009	160605100
A10U1763	160-6052-00			MICROCKT,DGTL:LOGIC ARRAY,PRGM	80009	160605200
A10U1764	156-3491-00			MICROCKT,DGTL:QUAD,2 INPUT & GATE	TK0EN	MC74HC08N
A10U1765	156-2463-00			IC,DGTL:HCMOS,GATE;QUAD 2-INPUT OR;74HC32,D	18324	74HC32N
A10U1766	156-2026-00			IC,DIGITAL:HCCMOS,GATES;QUAD 2-INPUT NOR;74	04713	MC74HC02AN
A10U1767	156-1611-00			IC,DIGITAL:FTTL,FLIP FLOP;DUAL D-TYPE;74F74	04713	MC74F74N
A10U2001	160-6058-00			MICROCKT,DGTL:LOGIC ARRAY,PRGM	80009	160605800
A10U2002	156-3069-00			IC,DIGITAL:HCMOS,FLIP FLOP;OCTAL D-TYPE, NO	01295	SN74HC574N
A10U2003	156-3069-00			IC,DIGITAL:HCMOS,FLIP FLOP;OCTAL D-TYPE, NO	01295	SN74HC574N
A10U2005	156-3490-00			IC,MEMORY:CMOS,SRAM;8K X 8,150NS;,DIP28.6	TK0GB	D4364C-15L
A10U2006	156-3490-00			IC,MEMORY:CMOS,SRAM;8K X 8,150NS;,DIP28.6	TK0GB	D4364C-15L
A10U2008	160-6059-00			MICROCKT,DGTL:STTL,OCTAL 16 INPUT REG,PRGM	80009	160605900
A10U2251	156-2256-00			IC,DIGITAL:HCMOS,GATES;QUAD 2-INPUT NAND;74	01295	SN74HC00N3/J4
A10U2253	156-2026-00			IC,DIGITAL:HCCMOS,GATES;QUAD 2-INPUT NOR;74	04713	MC74HC02AN
A10U2254	156-2009-00			IC,DIGITAL:HCCMOS,FLIP FLOP;DUAL D-TYPE;74H	04713	MC74HC74AN
A10U2255	156-2463-00			IC,DGTL:HCMOS,GATE;QUAD 2-INPUT OR;74HC32,D	18324	74HC32N
A10U2256	156-3063-00			IC,DGTL:HCMOS,DEMUX;QUAD 2-TO-4 DECODER;74H	01295	SN 74HC139N
A10U2257	156-2761-00			IC,DIGITAL:HCCMOS,GATES;DUAL NON RETRIG MON	TK1016	TC74HC221P
A10U2258	156-2009-00			IC,DIGITAL:HCCMOS,FLIP FLOP;DUAL D-TYPE;74H	04713	MC74HC74AN
A10U2259	160-6053-01			MICROCRT,DGTL:LOGIC ARRAY,PRGM	80009	160605301
A10U2261	160-6054-00			MICROCKT,DGTL:LOGIC ARRAY,PRGM	80009	160605400
A10U2262	160-5384-00			MICROCKT,DGTL:LOGIC ARRAY,PRGM	TK0GA	PAL 22V10-25
A10U3001	156-2027-00			IC,DIGITAL:HCCMOS,GATES;HEX INV;74HC04,DIP1	27014	MM74HC04N
A10U3002	156-2027-00			IC,DIGITAL:HCCMOS,GATES;HEX INV;74HC04,DIP1	27014	MM74HC04N
A10U3005	156-2009-00			IC,DIGITAL:HCCMOS,FLIP FLOP;DUAL D-TYPE;74H	04713	MC74HC74AN
A10U3006	156-1756-00			IC,DIGITAL:ALSTTL,FLIP FLOP;DUAL D-TYPE W/C	01295	SN74ALS74A (N O

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A10U3203	156-3692-00			MICROCKT: (.74HCT132P)	80009	156369200
A10U3204	156-2026-00			IC,DIGITAL:HCCMOS,GATES;QUAD 2-INPUT NOR;74	04713	MC74HC02AN
A10U7001	119-1460-00			OSCILLATOR,RF:40.0MHZ	01537	K1100AM 40 MHz
A10U7002	156-1707-00			IC,DIGITAL:FTTL,GATES;QUAD 2-INPUT NAND;74F	04713	MC74F00 (N OR J
A10U7003	156-2251-00			IC,DIGITAL:FTTL,COUNTER;SYNCH 4-BIT BINARY;	04713	MC74F161AN
A10U7006	156-1973-00			IC,DIGITAL:FTTL,FLIP FLOP;QUAD D-TYPE, CLEA	18324	N74F175N
A10U7007	156-1662-00			IC,DIGITAL:FTTL,MUX;DUAL 4-TO-1 DATA SELECT	04713	MC74F153N
A10U7008	156-1611-00			IC,DIGITAL:FTTL,FLIP FLOP;DUAL D-TYPE;74F74	04713	MC74F74N
A10U7009	156-1743-00			IC,DIGITAL:FTTL,GATES;QUAD 2-INPUT NOR;74F0	04713	MC74F02N
A10U7010	156-2333-00			IC,DIGITAL:ALSTTL,COUNTER;SYNCH 4-BIT DECAD	01295	SN74ALS162BN3
A10U7011	156-2333-00			IC,DIGITAL:ALSTTL,COUNTER;SYNCH 4-BIT DECAD	01295	SN74ALS162BN3
A10U7012	156-2333-00			IC,DIGITAL:ALSTTL,COUNTER;SYNCH 4-BIT DECAD	01295	SN74ALS162BN3
A10U7013	156-2333-00			IC,DIGITAL:ALSTTL,COUNTER;SYNCH 4-BIT DECAD	01295	SN74ALS162BN3
A10U7014	156-2333-00			IC,DIGITAL:ALSTTL,COUNTER;SYNCH 4-BIT DECAD	01295	SN74ALS162BN3
A10U7015	156-2333-00			IC,DIGITAL:ALSTTL,COUNTER;SYNCH 4-BIT DECAD	01295	SN74ALS162BN3
A10U7016	156-2176-00			IC,DIGITAL:ALSTTL,GATES;TRIPLE 3-INPUT AND;	01295	SN74ALS11AN
A10U7017	156-1611-00			IC,DIGITAL:FTTL,FLIP FLOP;DUAL D-TYPE;74F74	04713	MC74F74N
A10U7020	156-3064-00			IC,DGTL:HCMOS,MUX;QUAD 2-TO-1 DATA SELECTOR	01295	SN74HC164N
A10U7021	156-1611-00			IC,DIGITAL:FTTL,FLIP FLOP;DUAL D-TYPE;74F74	04713	MC74F74N
A10W1292	174-1255-00			CA ASSY,SP,ELEC:6,26 AWG,150MM L,RIBBON	TK0EM	ORDER BY DESCRI

Component Number	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A11	671-1612-00			CIRCUIT BD ASSY:A11 CURSOR	80009	671161200
A11C1300	281-0785-00			CAP,FXD,CER DI:68PF,10%,100V	04222	SA101A680KAA
A11C1301	281-0777-00			CAP,FXD,CER DI:51PF,5%,100V	04222	SA101A510JAA
A11C1302	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1303	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1304	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1305	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1306	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1307	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1308	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1309	281-0812-00			CAP,FXD,CER DI:1000PF,10%,100V	04222	SA101C102KAA
A11C1310	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1311	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1312	290-1150-00			CAP,FXD,ELCTLT:15UF,+50%-10%,16WVDC	K8996	030-25159
A11C1313	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1314	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1315	281-0756-00			CAP,FXD,CER DI:2.2PF,+/-0.5PF,200V	04222	SA102A2R2DAA
A11C1316	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1317	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1320	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1321	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1322	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1323	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1324	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1326	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1328	283-0999-00			CAP,FXD,CER DI:0.02UF,+100/-25%,50V	80009	283099900
A11C1332	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1333	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1334	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1341	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1342	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1343	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1344	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1345	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1360	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	TK1743	CGB103KEX
A11C1361	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1362	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1363	281-0762-00			CAP,FXD,CER DI:27PF,20%,100V	04222	SA101A270MAA
A11C1364	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1366	281-0814-00			CAP,FXD,CER DI:100 PF,10%,100V	TK1743	CGB101KEN
A11C1367	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1368	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1370	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1371	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	TK1743	CGB103KEX
A11C1372	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1373	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1374	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1375	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1378	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A11C1392	281-0814-00			CAP,FXD,CER DI:100 PF,10%,100V	TK1743	CGB101KEN
A11C1393	281-0765-00			CAP,FXD,CER DI:100PF,5%,100V	04222	SA102A101JAA
A11CR1302	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A11CR1362	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A11CR1363	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427
A11CR1367	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	07263	FDH9427

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A11CR1368	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A11CR1369	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A11CR1373	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A11CR1374	152–0141–02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO–35	07263	FDH9427
A11J1301	204–1034–00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TK0EM	52011–0610
A11J1303	204–1033–00			CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TK0EM	52011–0410
A11J1304	204–1033–00			CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TK0EM	52011–0410
A11J1306	136–0756–00			SKT,PL–IN ELEK:MICROCIRCUIT,18 DIP	09922	DILB18P–108
A11J1307	204–1034–00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TK0EM	52011–0610
A11J1315	136–0755–00			SKT,PL–IN ELEK:MICROCIRCUIT,28 DIP	09922	DILB28P–108
A11Q1312	151–0188–00			TRANSISTOR:PNP,SI,TO–92	04713	2N3906
A11Q1377	151–0188–00			TRANSISTOR:PNP,SI,TO–92	04713	2N3906
A11R1211	315–0102–00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1300	315–0102–00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1301	315–0102–00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1302	307–1477–00			RES NTWK,FXD,FI:10K OHM X 8,1%,0.125W	TK0FX	ORDER BY DESCRI
A11R1303	307–1477–00			RES NTWK,FXD,FI:10K OHM X 8,1%,0.125W	TK0FX	ORDER BY DESCRI
A11R1304	315–0333–00			RES,FXD,FILM:33K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1305	315–0102–00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1306	315–0102–00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1307	321–0097–00			RES,FXD,FILM:100 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322–151–9
A11R1308	307–1524–00			RES,VAR,NONWW:10K DUAL,10K MONENTARY SW	80009	307152400
A11R1310	315–0331–00			RES,FXD,FILM:330 OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1311	315–0392–00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1312	315–0103–00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1313	321–0222–00			RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=T0	19701	5033ED2K00F
A11R1314	321–0126–00			RES,FXD,FILM:200 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322–151–2
A11R1315	321–0433–00			RES,FXD,FILM:316K OHM,1%,0.125W,TC=T0	19701	5043ED316K0F
A11R1316	315–0392–00			RES,FXD,FILM:3.9K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1317	315–0102–00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1321	315–0393–00			RES,FXD,FILM:39K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1323	315–0103–00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1324	315–0103–00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1325	315–0103–00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1326	315–0103–00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1327	315–0103–00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1328	315–0102–00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1330	315–0104–00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1331	315–0104–00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1332	315–0104–00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1333	315–0104–00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1334	315–0151–00			RES,FXD,FILM:150 OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1335	315–0103–00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1336	315–0103–00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1337	315–0103–00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1338	315–0103–00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1339	315–0103–00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1340	321–0208–00			RES,FXD,FILM:1.43K OHM,1%,0.125W,TC=T0	19701	5043ED1K43F
A11R1341	315–0102–00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A11R1342	321–0208–00			RES,FXD,FILM:1.43K OHM,1%,0.125W,TC=T0	19701	5043ED1K43F
A11R1343	321–0318–00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
A11R1344	311–2354–00			RES,VAR,NONWW:TRMR,4.7K OHM,0.5W	K8788	TC10–LH2.5–4K7/
A11R1345	321–0178–00			RES,FXD,FILM:698 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322–151–6
A11R1346	321–0210–00			RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=T0	19701	5033ED1K50F
A11R1347	311–2420–00			RES,VAR,NONWW:TRMR,10K	K8788	ORDER BY DESCRI

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A11R1348	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A11R1349	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A11R1350	176-0231-00			WIRE,ELECTRICAL:22 AWG,TINNED	K3176	ORDER BY DESCRI
A11R1351	321-0361-00			RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=T0	19701	5043ED56K20F
A11R1352	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A11R1353	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A11R1354	315-0125-00			RES,FXD,FILM:1.2M OHM,5%,0.25W	TK1727	SFR25 2322-181-
A11R1355	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A11R1356	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	TK1727	SFR25 2322-181-
A11R1357	321-0459-00			RES,FXD,FILM:590K OHM,1%,0.125W,TC=T0	19701	5043ED590K0F
A11R1358	315-0103-00	200078		RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A11R1359	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A11R1360	321-0225-00			RES,FXD,FILM:2.15K OHM,1%,0.125W,TC=T0	19701	5033ED2K15F
A11R1361	321-0130-00			RES,FXD,FILM:221 OHM,1%,0.125W,TC=T0	19701	5043ED221R0F
A11R1362	321-0130-00			RES,FXD,FILM:221 OHM,1%,0.125W,TC=T0	19701	5043ED221R0F
A11R1363	321-0172-00			RES,FXD,FILM:604 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A11R1364	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A11R1365	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A11R1366	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A11R1367	311-2420-00			RES,VAR,NONWW:TRMR,10K	K8788	ORDER BY DESCRI
A11R1368	321-0172-00			RES,FXD,FILM:604 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-6
A11R1369	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-4
A11R1370	321-0255-00			RES,FXD,FILM:4.42K OHM,1%,0.125W,TC=T0	19701	5043ED4K420F
A11R1371	321-0361-00			RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=T0	19701	5043ED56K20F
A11R1372	311-2420-00			RES,VAR,NONWW:TRMR,10K	K8788	ORDER BY DESCRI
A11R1373	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A11R1374	307-1477-00			RES NTWK,FXD,FI:10K OHM X 8,1%,0.125W	TK0FX	ORDER BY DESCRI
A11R1375	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A11R1376	311-2420-00			RES,VAR,NONWW:TRMR,10K	K8788	ORDER BY DESCRI
A11R1377	321-0210-00			RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=T0	19701	5033ED1K50F
A11R1378	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A11R1379	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=T0	TK1727	MR25 2322-151-1
A11R1380	321-0149-00			RES,FXD,FILM:348 OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-3
A11R1381	321-0392-00			RES,FXD,FILM:118K OHM,1%,0.125W,TC=T0	19701	5043ED118K0F
A11R1382	311-2420-00			RES,VAR,NONWW:TRMR,10K	K8788	ORDER BY DESCRI
A11R1384	315-0125-00			RES,FXD,FILM:1.2M OHM,5%,0.25W	TK1727	SFR25 2322-181-
A11R1387	321-0459-00			RES,FXD,FILM:590K OHM,1%,0.125W,TC=T0	19701	5043ED590K0F
A11R1389	321-0361-00			RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=T0	19701	5043ED56K20F
A11R1390	321-0251-00			RES,FXD,FILM:4.02K OHM,1%,0.125W,TC=T0	19701	5043ED4K020F
A11R1391	321-0251-00			RES,FXD,FILM:4.02K OHM,1%,0.125W,TC=T0	19701	5043ED4K020F
A11R1392	321-0235-00			RES,FXD,FILM:2.74K OHM,1%,0.125W,TC=T0	19701	5043ED2K740F
A11R1393	321-0199-00			RES,FXD,FILM:1.15K OHM,1%,0.125W,TC=T0	TK1727	MR25 2322-151-1
A11R1395	321-0130-00			RES,FXD,FILM:221 OHM,1%,0.125W,TC=T0	19701	5043ED221R0F
A11R1396	321-0130-00			RES,FXD,FILM:221 OHM,1%,0.125W,TC=T0	19701	5043ED221R0F
A11R1397	321-0098-00			RES,FXD,FILM:102 OHM,1%,0.125W,TC=T0	19701	5043ED102R0F
A11R1398	321-0098-00			RES,FXD,FILM:102 OHM,1%,0.125W,TC=T0	19701	5043ED102R0F
A11R1399	315-0202-00			RES,FXD,FILM:2K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A11S1335	260-2462-00			PUSH BUTTON:4 POS,2 POLE,2 LATCH,2 MOM	80009	260246200
A11U1300	156-3201-00			IC,DIGITAL:HCTCMOS,GATE;HEX INV;74HCT04,DIP	18324	74HCT04N
A11U1302	156-3628-00			MICROCKT,DGTL:MOS,8-BIT MICROPROCESSOR	80009	156362800
A11U1303	156-2134-00			IC,DIGITAL:HCTCMOS,LATCH;OCTAL D-TYPE TRANS	02735	CD74HCT373E
A11U1304	156-3490-00			IC,MEMORY:CMOS,SRAM;8K X 8,150NS;,DIP28.6	TK0GB	D4364C-15L
A11U1305	156-3719-01			MICROCKT,DGTL CMOS,EPROM	80009	156371901
A11U1306	156-3625-00			MICROCKT,DGTL:CMOS,3 TO 8 LINE DEMUX	80009	156362500
A11U1307	156-3625-00			MICROCKT,DGTL:CMOS,3 TO 8 LINE DEMUX	80009	156362500

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A11U1308	156-2256-00			IC,DIGITAL:HCMOS,GATES;QUAD 2-INPUT NAND;74	01295	SN74HC00N3/J4
A11U1309	156-2134-00			IC,DIGITAL:HCTCMOS,LATCH;OCTAL D-TYPE TRANS	02735	CD74HCT373E
A11U1310	156-3623-00			MICROCKT,DGTL:CMOS,4 BIT COUNTER	80009	156362300
A11U1311	156-3623-00			MICROCKT,DGTL:CMOS,4 BIT COUNTER	80009	156362300
A11U1312	156-3623-00			MICROCKT,DGTL:CMOS,4 BIT COUNTER	80009	156362300
A11U1313	156-3623-00			MICROCKT,DGTL:CMOS,4 BIT COUNTER	80009	156362300
A11U1314	156-1611-00			IC,DIGITAL:FTTL,FLIP FLOP;DUAL D-TYPE;74F74	04713	MC74F74N
A11U1315	156-3490-00			IC,MEMORY:CMOS,SRAM;8K X 8,150NS;,DIP28.6	TK0GB	D4364C-15L
A11U1320	160-6060-01			MICROCKT,DGTL: STTL,OCTAL 16 INPUT REG,PRGM	80009	160606001
A11U1321	156-3623-00			MICROCKT,DGTL:CMOS,4 BIT COUNTER	80009	156362300
A11U1322	156-3623-00			MICROCKT,DGTL:CMOS,4 BIT COUNTER	80009	156362300
A11U1323	156-3623-00			MICROCKT,DGTL:CMOS,4 BIT COUNTER	80009	156362300
A11U1324	156-3623-00			MICROCKT,DGTL:CMOS,4 BIT COUNTER	80009	156362300
A11U1325	156-2355-00			IC,DIGITAL:HCTCMOS,COUNTER;14 STAGE BINARY	02735	CD74HCT4020E
A11U1326	160-6061-01			MICROCKT,DGTL: STTL,OCTAL 16 INPUT REG,PRGM	80009	160606101
A11U1328	156-3626-00			MICROCKT,DGTL:CMOS,QUAD,ZIP NOR	80009	156362600
A11U1340	156-0991-00			MICROCKT,LINEAR:VOLTAGE REGULATOR	04713	MC78L05ACP
A11U1341	156-3622-00			MICROCKT,DGTL:CMOS,A/D 8 BIT,8 INPUT	80009	156362200
A11U1342	156-3624-00			MICROCKT,DGTL:CMOS,8 BIT SERIAL IN/OUT	80009	156362400
A11U1343	156-2027-00			IC,DIGITAL:HCCMOS,GATES;HEX INV;74HC04,DIP1	27014	MM74HC04N
A11U1344	156-0853-00			IC,LINEAR:BIPOLAR,OP-AMP;DUAL,SINGLE SUPPLY	04713	LM358N
A11U1345	156-3065-00			IC,DIGITAL:HCMOS,SHIFT REGISTER;8-BIT PISO;	01295	SN74HC165N
A11U1350	156-0853-00			IC,LINEAR:BIPOLAR,OP-AMP;DUAL,SINGLE SUPPLY	04713	LM358N
A11U1360	156-2357-00			IC,DIGITAL:HCTCMOS,FLIP FLOP;OCTAL D-TYPE,	01295	SN74HCT574N
A11U1361	156-1255-00			MICROCKT,LINEAR:D/A CONVERTER,8 BIT	06665	DAC08-157Q(STD
A11U1362	156-0048-00			MICROCKT,LINEAR:5 XSTR ARRAY	02735	CA3046
A11U1363	156-0048-00			MICROCKT,LINEAR:5 XSTR ARRAY	02735	CA3046
A11U1364	156-2357-00			IC,DIGITAL:HCTCMOS,FLIP FLOP;OCTAL D-TYPE,	01295	SN74HCT574N
A11U1365	156-1958-00			MICROCKT,DGTL:HCMOS,MUX;QUAD 2-TO-1 DATA SE	TK1016	TC74HC157P
A11U1369	160-6062-01			MICROCKT,DGTL: STTL,OCTAL 16 INPUT REG,PRGM	80009	160606201
A11U1370	156-2357-00			IC,DIGITAL:HCTCMOS,FLIP FLOP;OCTAL D-TYPE,	01295	SN74HCT574N
A11U1371	156-2357-00			IC,DIGITAL:HCTCMOS,FLIP FLOP;OCTAL D-TYPE,	01295	SN74HCT574N
A11U1372	156-1255-00			MICROCKT,LINEAR:D/A CONVERTER,8 BIT	06665	DAC08-157Q(STD
A11U1373	156-2956-00			MICROCKT,LINEAR:DUAL,INDEP PIFF AMPL	K5856	CA 3054
A11W1302	174-1551-00			CA ASSY,SP,ELEC:3.0 L,RIBBON	80009	174155100
A11Y1300	158-0358-00			XTAL UNIT,QTZ:4.9152MHZ,20PPM,PAR	80009	158035800

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A21	671–1611–00			CIRCUIT BD ASSY:SIO	80009	671161100
A21C1201	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1203	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1205	281–0762–00			CAP,FXD,CER DI:27PF,20%,100V	04222	SA101A270MAA
A21C1209	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1210	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1211	281–0762–00			CAP,FXD,CER DI:27PF,20%,100V	04222	SA101A270MAA
A21C1212	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1214	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1216	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1217	281–0814–00			CAP,FXD,CER DI:100 PF,10%,100V	TK1743	CGB101KEN
A21C1220	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1222	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1224	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1226	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1228	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1230	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1232	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1234	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1236	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1245	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1251	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1252	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1253	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1254	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1255	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1270	281–0814–00			CAP,FXD,CER DI:100 PF,10%,100V	TK1743	CGB101KEN
A21C1271	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1272	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1273	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1274	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1275	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1276	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1277	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1278	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1279	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1281	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1282	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1286	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1287	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1288	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1289	281–0775–01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A21C1293	290–1150–00			CAP,FXD,ELCTLT:15UF,+50%–10%,16WVDC	K8996	030–25159
A21C1299	290–1153–00			CAP,FXD,ELCTLT:47UF,+50–10%,10V	K8996	030–24479
A21J1253	136–0755–00			SKT,PL–IN ELEK:MICROCIRCUIT,28 DIP	09922	DILB28P–108
A21J1292	204–1093–00			CONN BODY,RCPT:1 X 6,90 DEG	80009	204109300
A21J1302	136–0756–00			SKT,PL–IN ELEK:MICROCIRCUIT,18 DIP	09922	DILB18P–108
A21J1305	136–0756–00			SKT,PL–IN ELEK:MICROCIRCUIT,18 DIP	09922	DILB18P–108
A21L1299	120–1631–00			COIL,RF:FXD,210UH	TK00A	ORDER BY DESCRI
A21R1205	315–0102–00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A21R1207	315–0103–00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A21R1217	315–0102–00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A21R1243	315–0103–00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A21R1244	315–0333–00			RES,FXD,FILM:33K OHM,5%,0.25W	TK1727	SFR25 2322–181–
A21R1245	307–1477–00			RES NTWK,FXD,FI:10K OHM X 8,1%,0.125W	TK0FX	ORDER BY DESCRI

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A21R1246	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A21R1247	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A21R1270	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A21R1287	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A21R1289	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A21R1291	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A21R1293	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A21R1294	307-1477-00			RES NTWK,FXD,FI:10K OHM X 8,1%,0.125W	TK0FX	ORDER BY DESCRI
A21R1295	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A21R1296	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	TK1727	SFR25 2322-181-
A21R1297	307-1477-00			RES NTWK,FXD,FI:10K OHM X 8,1%,0.125W	TK0FX	ORDER BY DESCRI
A21U1228	156-2415-00			IC,DGTL:HCMOS,BUS TRANSCEIVER;OCTAL, NONINV	27014	MM74HC245AN
A21U1230	156-2256-00			IC,DIGITAL:HCMOS,GATES;QUAD 2-INPUT NAND;74	01295	SN74HC00N3/J4
A21U1232	156-2415-00			IC,DGTL:HCMOS,BUS TRANSCEIVER;OCTAL, NONINV	27014	MM74HC245AN
A21U1253	160-6055-02			MICROCKT,DGTL:EPROM,PRGM;AM27C256-200DC	80009	160605502
A21U1254	156-2421-00			IC,DIGITAL:HCCMOS,FLIP FLOP;QUAD D-TYPE, CL	04713	MC74HC175N
A21U1260	156-3493-00			MICROCKT,DGTL:HEX INVERTER	K5856	CD74HC14
A21U1271	156-1646-00			IC,DIGITAL:HCMOS,FLIP FLOP;D-TYPE W/3-STATE	18324	74HCT374N
A21U1273	156-2027-00			IC,DIGITAL:HCCMOS,GATES;HEX INV;74HC04,DIP1	27014	MM74HC04N
A21U1274	156-1646-00			IC,DIGITAL:HCMOS,FLIP FLOP;D-TYPE W/3-STATE	18324	74HCT374N
A21U1275	156-1646-00			IC,DIGITAL:HCMOS,FLIP FLOP;D-TYPE W/3-STATE	18324	74HCT374N
A21U1277	156-1762-00			IC,DIGITAL:HCMOS,COUNTER;SYNCH 4-BIT BINARY	TK1016	TC74HC161P
A21U1278	156-1762-00			IC,DIGITAL:HCMOS,COUNTER;SYNCH 4-BIT BINARY	TK1016	TC74HC161P
A21U1279	156-1762-00			IC,DIGITAL:HCMOS,COUNTER;SYNCH 4-BIT BINARY	TK1016	TC74HC161P
A21U1280	156-1762-00			IC,DIGITAL:HCMOS,COUNTER;SYNCH 4-BIT BINARY	TK1016	TC74HC161P
A21U1281	156-1762-00			IC,DIGITAL:HCMOS,COUNTER;SYNCH 4-BIT BINARY	TK1016	TC74HC161P
A21U1282	156-1762-00			IC,DIGITAL:HCMOS,COUNTER;SYNCH 4-BIT BINARY	TK1016	TC74HC161P
A21U1286	156-2134-00			IC,DIGITAL:HCTCMOS,LATCH;OCTAL D-TYPE TRANS	02735	CD74HCT373E
A21U1287	156-3625-00			MICROCKT,DGTL:CMOS,3 TO 8 LINE DEMUX	80009	156362500
A21U1289	156-2580-00			IC,DIGITAL:HCCMOS,BUFFER/DRIVER;QUAD, LINE	TK1016	TC74HC126P
A21U1292	156-3693-00			IC: (MC68H68TIP)	80009	156369300
A21U1293	156-2026-00			IC,DIGITAL:HCCMOS,GATES;QUAD 2-INPUT NOR;74	04713	MC74HC02AN
A21W1305	174-1553-00			CA ASSY,SP,ELEC:3.0 L,RIBBON	80009	174155300

Component Number	Tektronix Part No.	Serial No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
J100	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	TK1725	G35152BN
J151	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	TK1725	G35152BN
J300	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	TK1725	G35152BN
J590	131-3898-00			TERM,FEEDTHRU:0.658 M X 0.75 DIA,BRS,AU PL	K0491	001-1401-041140
T901	120-1798-00			TRANSFORMER,RF:TORIODAL,MAINS	K5545	ORDER BY DESCRI

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols

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 is in 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.

American National Standard Institute
1430 Broadway
New York, New York 10018

Component Values

Electrical components shown on the diagrams are in the following units unless noted otherwise:

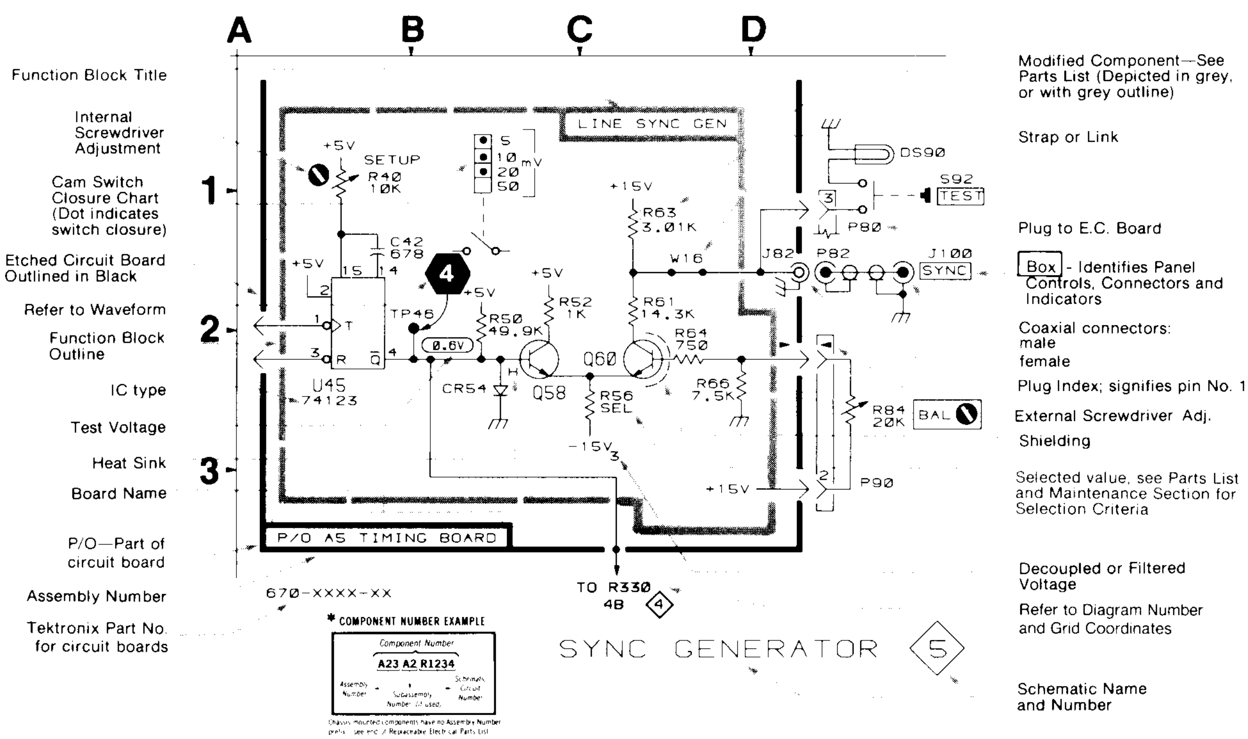
Capacitors = Values one or greater are in picofarads (pF). Values less than one are in microfarads (μF).
Resistors = Ohms (Ω).

The information and special symbols below may appear in this manual.

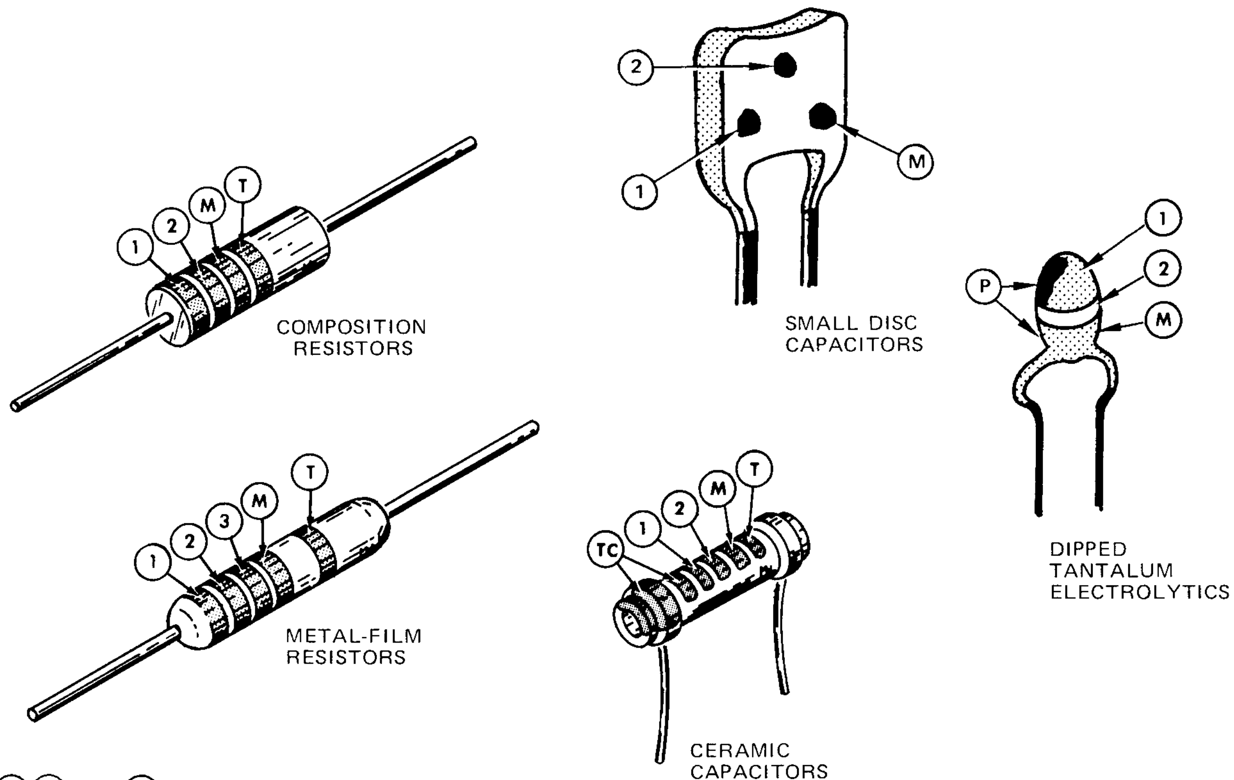
Assembly Numbers and Grid Coordinates

Each assembly in the instrument is assigned an assembly number (e.g., A20). The assembly number appears on the circuit board outline on the diagram, in the title for the circuit board component location illustration, and in the lookup table for the schematic diagram and corresponding component locator illustration. The Replaceable Electrical Parts list is arranged by assemblies in numerical sequence; the components are listed by component number *(see following illustration for constructing a component number).

The schematic diagram and circuit board component location illustration have grids. A lookup table with the grid coordinates is provided for ease of locating the component. Only the components illustrated on the facing diagram are listed in the lookup table. When more than one schematic diagram is used to illustrate the circuitry on a circuit board, the circuit board illustration may only appear opposite the first diagram on which it was illustrated; the lookup table will list the diagram number of other diagrams that the circuitry of the circuit board appears on.



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	---
GOLD	–	10^{-1} or 0.1	±5%	---	---	---	---
SILVER	–	10^{-2} or 0.01	±10%	---	---	---	---
NONE	–	---	±20%	---	±10%	±1 pF	---

(1861-20A)4206-31

Figure 9-1. Color codes for resistors and capacitors.

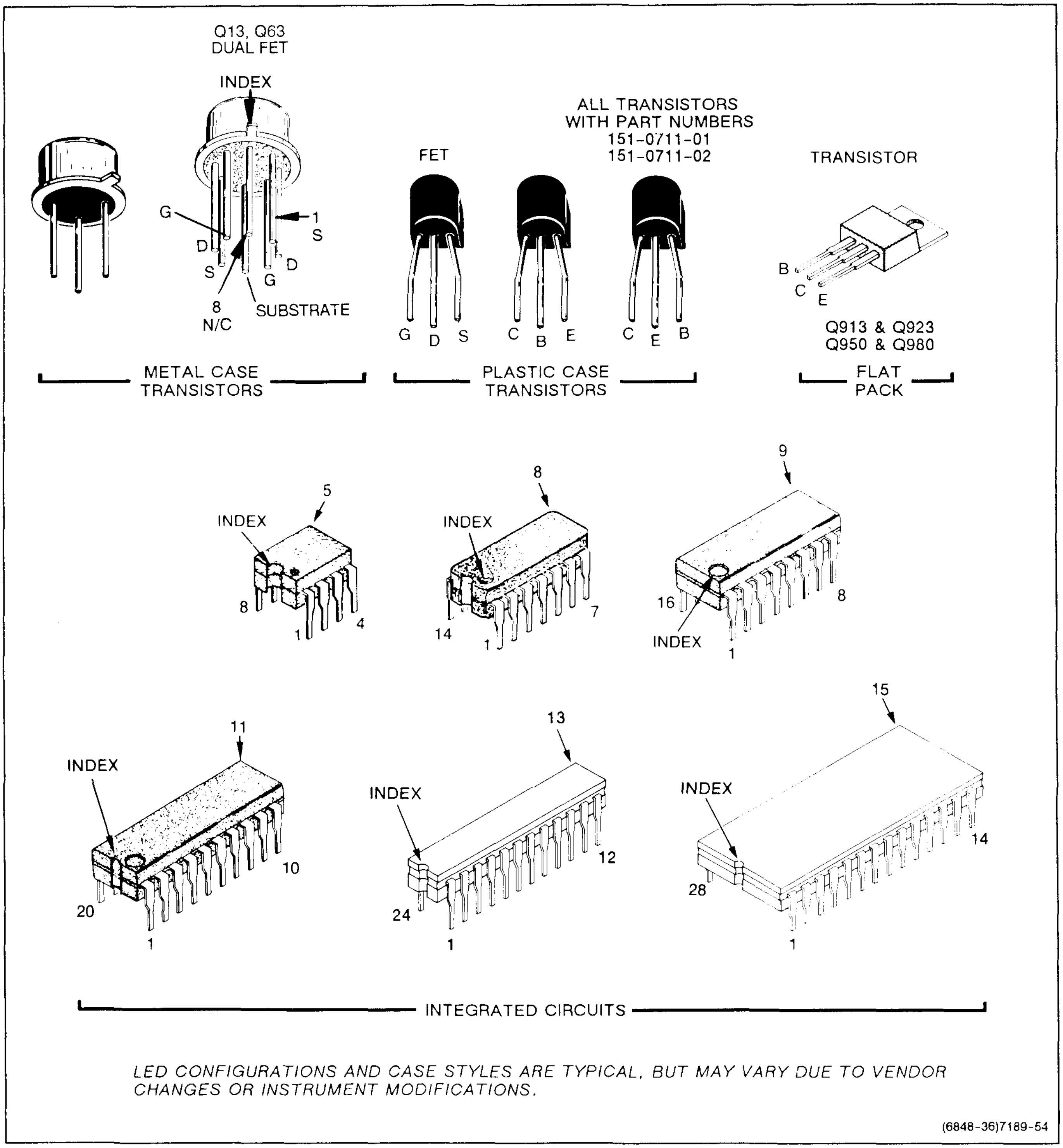


Figure 9-2. Semiconductor lead configurations.

To identify any component mounted on a circuit board and to locate that component in the schematic diagram.

1. Locate the Circuit Board Illustration.

   a. Identify the Assembly Number of the circuit board that the component is on by using the Circuit Board location illustration in this section or the mechanical parts exploded views at the rear of this manual.

   b. In the manual, locate the tabbed foldout page that corresponds with the Assembly Number of the circuit board. The circuit board assembly numbers and names are printed on the back side of the tabs (facing the rear of the manual).

2. Determine the Circuit Number and Schematic Diagram.

   a. Compare the circuit board with its illustration. Locate the component you are looking for by area and shape on the illustration to determine its Circuit Number.

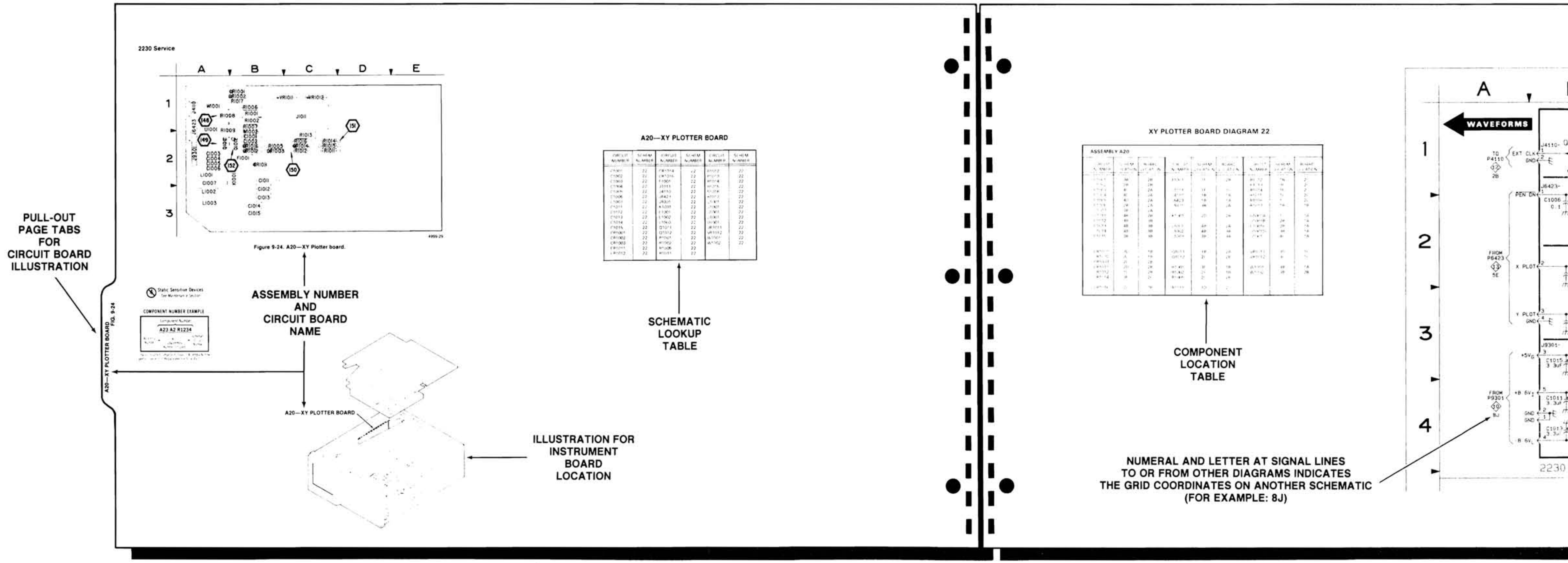
   b. Scan the lookup table next to the Circuit Board illustration to find the Circuit Number of the component.

   c. Read the SCHEM NUMBER column next to the component's circuit number to find the Schematic Diagram number.

3. Locate the Component on the Schematic Diagram.

   a. Locate the tabbed page that corresponds to the Schematic Diagr... ber. Schematic diagram numbers and names are printed on the f... of the tabs (facing the front of the manual).

   b. Locate the Assembly Number in the Component Location look... next to the schematic diagram. Scan the CIRCUIT NUMBER c... that table to find the Circuit Number of the component you are lo... in the schematic.



To identify any component in a schematic diagram and to locate that component on its respective circuit board.

1. Determine the Circuit Board Illustration and Component Location.

   a. From the schematic diagram, determine the Assembly Number of the circuit board that the component is on. The Assembly Number and Name is boxed and located in a corner of the heavy line marking the circuit board outline in the schematic diagram.

   b. Find the Component Location table for the Assembly Number found on the schematic. Scan the CIRCUIT NUMBER column to find the Circuit Number of the component.

   c. Look in the BOARD LOCATION column next to the component number and read its circuit board grid coordinates.

2. Locate the Component on the Circuit Board.

   a. In the manual, locate the tabbed page that corresponds to Assembly Number the component is on. Assembly numbers and names for circuit boards are on the back side of the tabs.

   b. Using the Circuit Number of the component and its given grid location, find the component in the Circuit Board illustration.

   c. From the small circuit board location illustration shown next to the circuit board, find the circuit board's location in the instrument.

   d. Find the circuit board in the instrument. Compare it with the circuit board illustration in the manual to locate the component on the circuit board itself.

Figure 9-3. Locating components on schematic diagrams and circuit board illustrations.

2. Determine the Circuit Number and Schematic Diagram.

a. Compare the circuit board with its illustration. Locate the component you are looking for by area and shape on the illustration to determine its Circuit Number.

b. Scan the lookup table next to the Circuit Board illustration to find the Circuit Number of the component.

c. Read the SCHEM NUMBER column next to the component's circuit number to find the Schematic Diagram number.

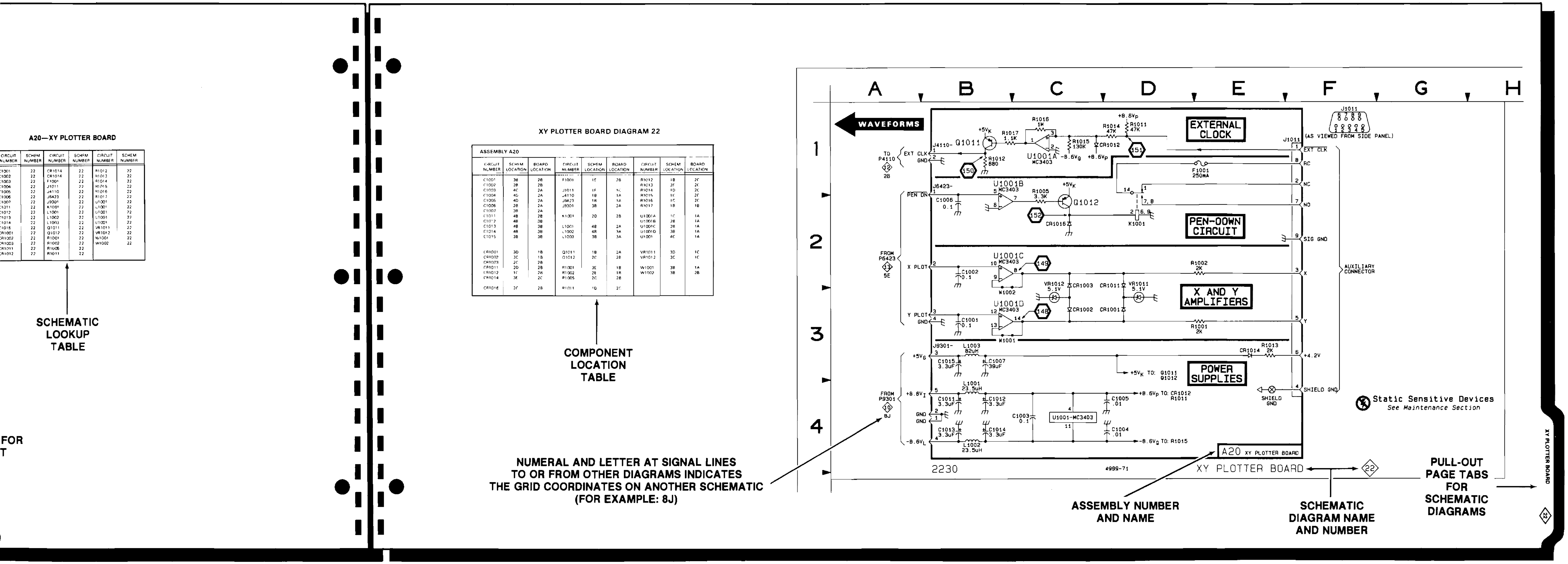
3. Locate the Component on the Schematic Diagram.

a. Locate the tabbed page that corresponds to the Schematic Diagram number. Schematic diagram numbers and names are printed on the front side of the tabs (facing the front of the manual).

b. Locate the Assembly Number in the Component Location lookup table next to the schematic diagram. Scan the CIRCUIT NUMBER column of that table to find the Circuit Number of the component you are looking for in the schematic.

c. In the SCHEM LOCATION column next to the component, read the grid coordinates of the component in the schematic.

d. Using the grid coordinates given, find the component in the schematic diagram.



2. Locate the Component on the Circuit Board.

a. In the manual, locate the tabbed page that corresponds to Assembly Number the component is on. Assembly numbers and names for circuit boards are on the back side of the tabs.

b. Using the Circuit Number of the component and its given grid location, find the component in the Circuit Board illustration.

c. From the small circuit board location illustration shown next to the circuit board, find the circuit board's location in the instrument.

d. Find the circuit board in the instrument. Compare it with the circuit board illustration in the manual to locate the component on the circuit board itself.

Figure 9-3. Locating components on schematic diagrams and circuit board illustrations.

6531-08

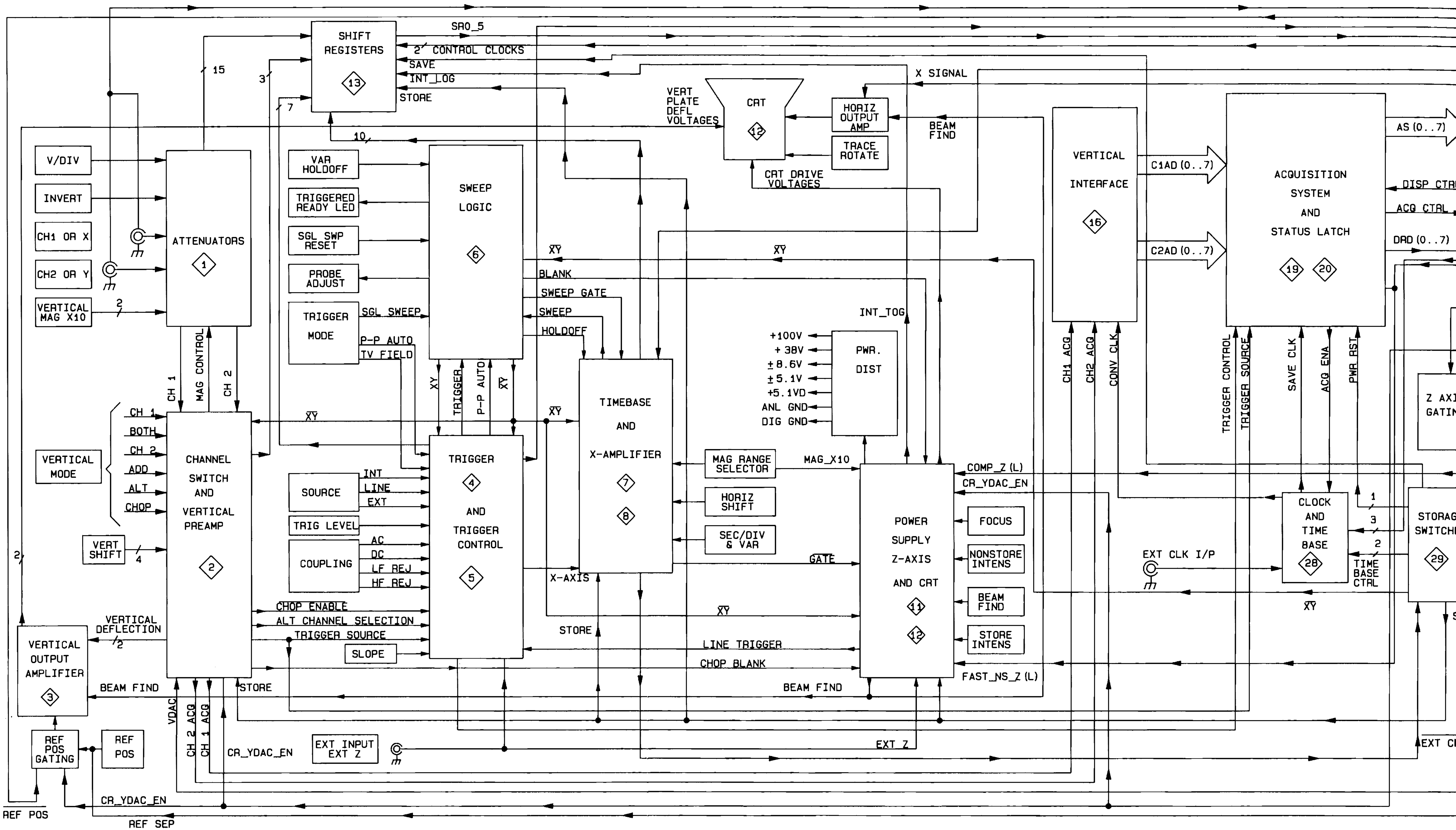


Figure 9-4. Simplified block diagram.

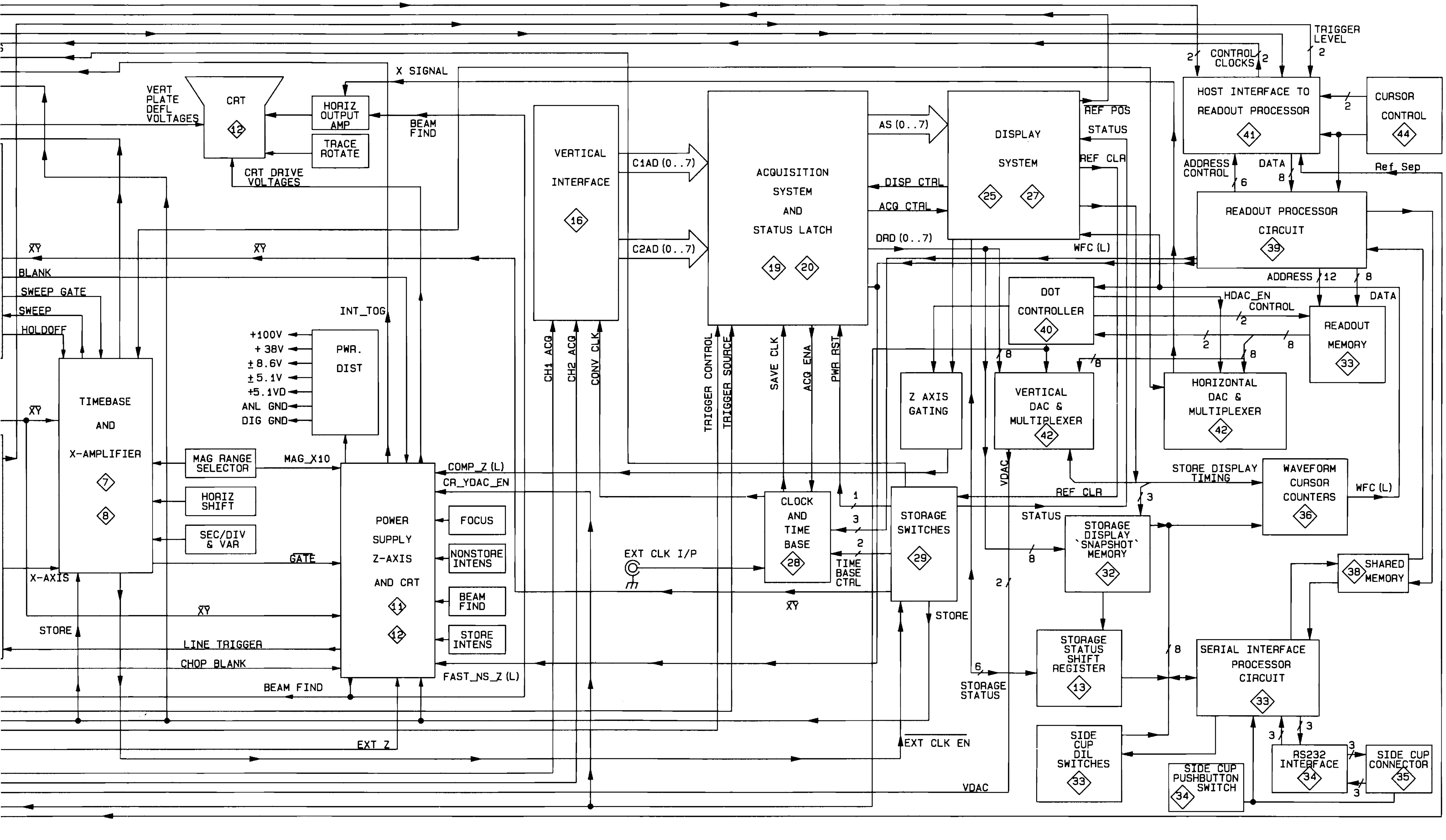


Figure 9-4. Simplified block diagram.

SIMPLIFIED BLOCK DIAGRAM

FIG. 9-4

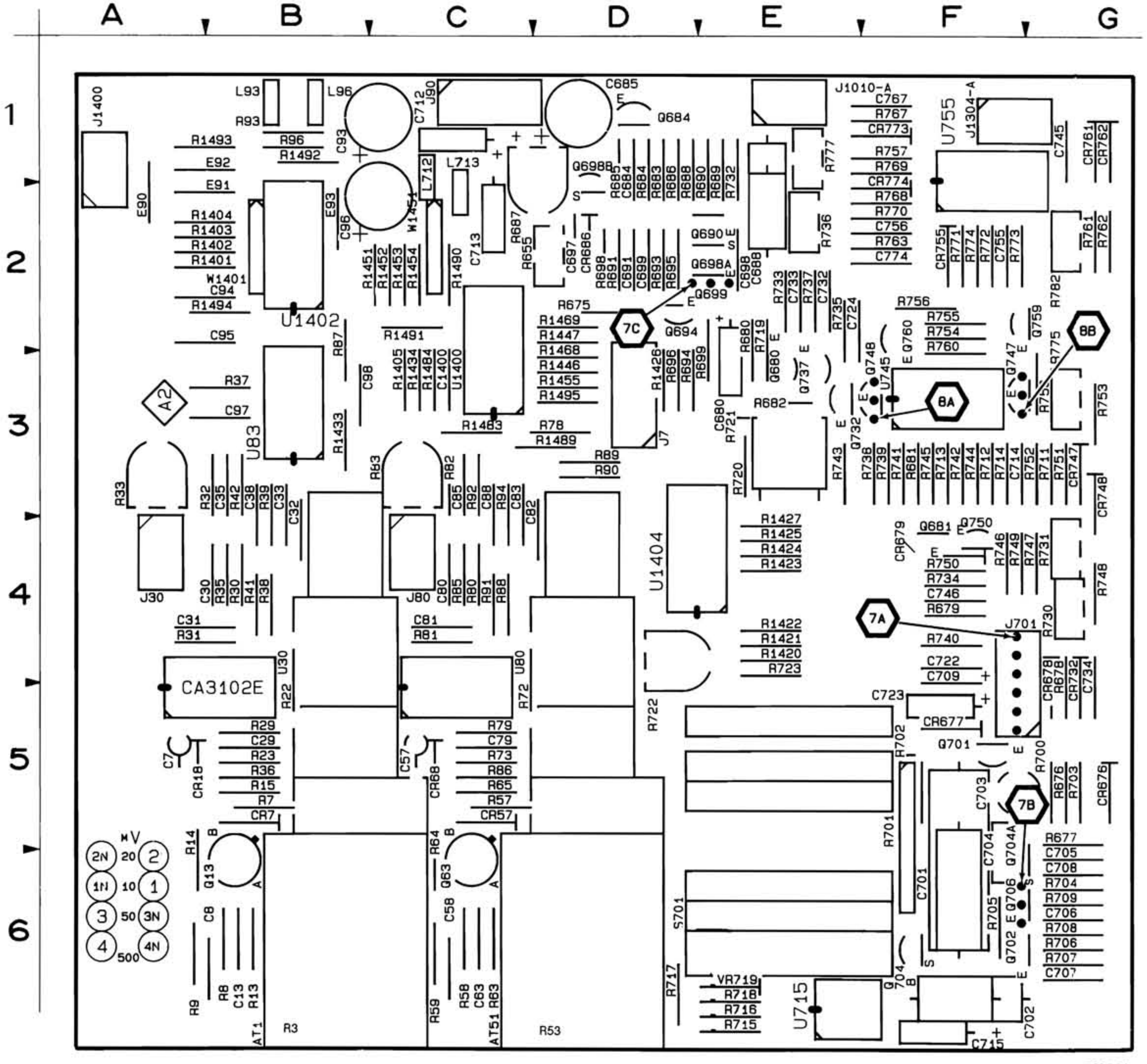


Figure 9-5. A2—Atten/Timebase board.

Static Sensitive Devices
See Maintenance Section

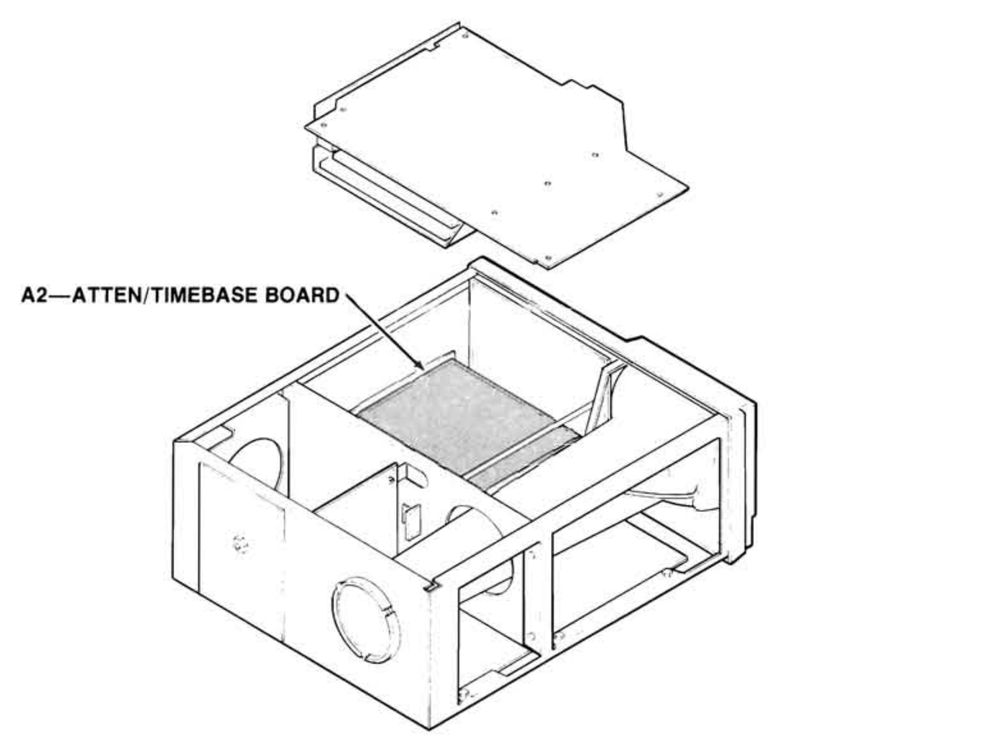
COMPONENT NUMBER EXAMPLE

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.



A2—ATTEN/TIMEBASE BOARD

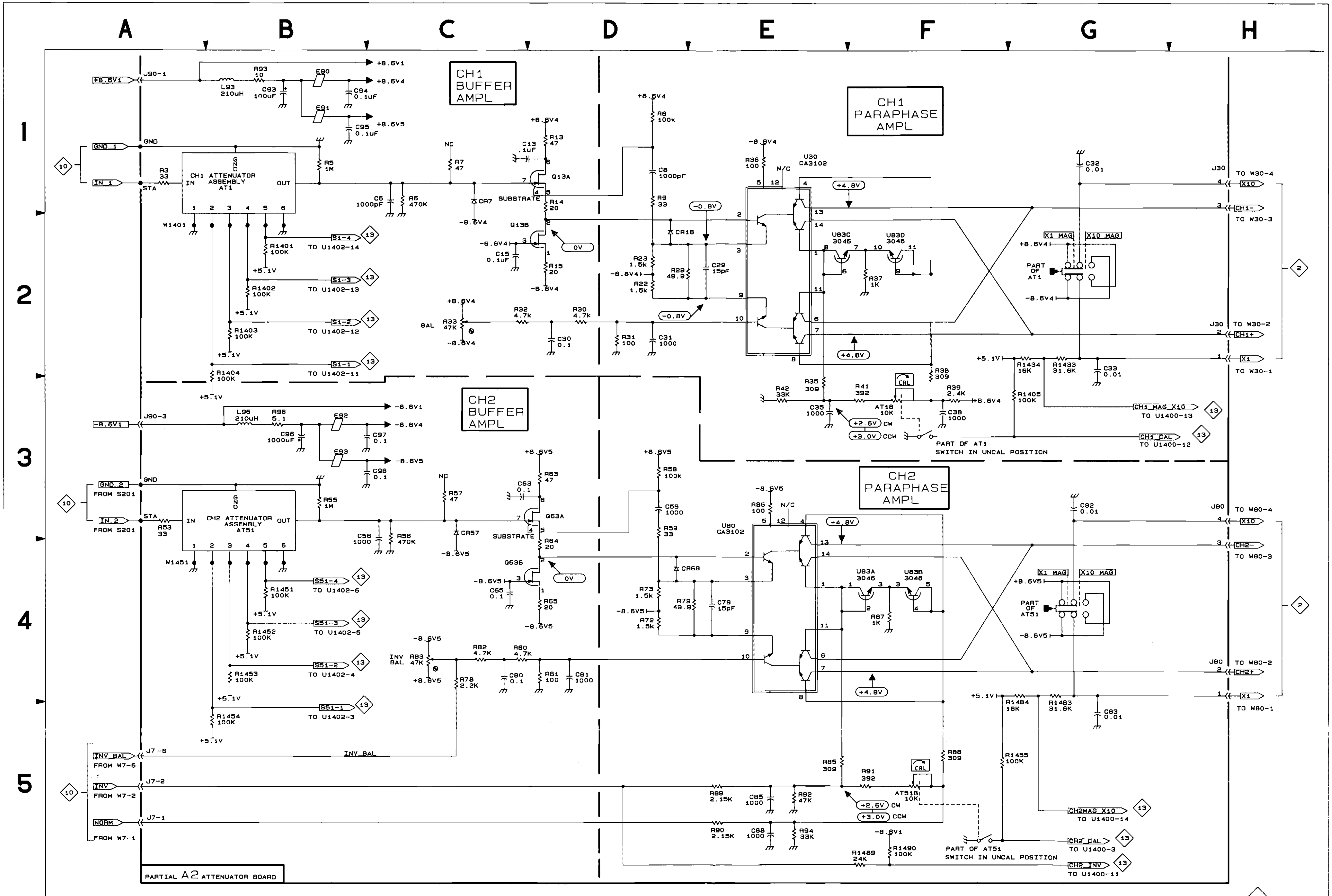
CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
AT1	1	C724	7	Q681	7	R73	1	R712	8	R775	8
AT51	1	C732	7	Q684	7	R78	1	R713	8	R777	8
		C733	7	Q690	7	R79	1	R714	8	R782	8
C6	1	C734	7	Q694	7	R80	1	R715	7	R1401	1
C8	1	C745	8	Q698A	7	R81	1	R716	7	R1402	1
C13	1	C746	8	Q698B	7	R82	1	R717	7	R1403	1
C15	1	C755	8	Q699	7	R83	1	R718	7	R1404	1
C29	1	C756	8	Q701	7	R85	1	R719	7	R1405	1
C30	1	C767	8	Q702	7	R86	1	R720	7	R1420	7
C31	1	C774	8	Q704A	7	R87	1	R721	7	R1421	7
C32	1	C1400	13	Q704B	7	R88	1	R722	7	R1422	7
C33	1			Q706	7	R89	1	R723	7	R1423	7
C35	1	CR7	1	Q732	7	R90	1	R730	8	R1424	7
C38	1	CR18	1	Q737	7	R91	1	R731	8	R1425	7
C56	1	CR57	1	Q747	8	R92	1	R732	7	R1426	7
C58	1	CR68	1	Q748	8	R93	1	R733	7	R1427	7
C63	1	CR676	7	Q750	8	R94	1	R734	7	R1433	1
C65	1	CR677	7	Q759	8	R96	1	R735	7	R1434	1
C79	1	CR678	7	Q760	8	R655	7	R736	7	R1446	8
C80	1	CR679	7			R675	7	R737	7	R1447	8
C81	1	CR686	7	R3	1	R676	7	R738	8	R1451	1
C82	1	CR732	7	R5	1	R677	7	R739	8	R1452	1
C83	1	CR747	8	R6	1	R678	7	R740	7	R1453	1
C85	1	CR748	8	R7	1	R679	7	R741	8	R1454	1
C88	1	CR755	8	R8	1	R680	7	R742	8	R1455	1
C93	1	CR761	8	R9	1	R681	7	R743	8	R1468	8
C94	1	CR762	8	R13	1	R682	7	R744	8	R1469	8
C95	1	CR773	8	R14	1	R683	7	R745	8	R1483	1
C96	1	CR774	8	R15	1	R684	7	R746	8	R1484	1
C97	1			R22	1	R685	7	R747	8	R1489	1
C98	1	E90	1	R23	1	R686	7	R748	8	R1490	1
C680	7	E91	1	R29	1	R687	7	R749	8	R1491	13
C684	7	E92	1	R30	1	R688	7	R750	8	R1492	13
C685	7	E93	1	R31	1	R689	7	R751	8	R1493	13
C688	7			R32	1	R690	7	R752	8	R1494	13
C691	7	J7	1	R33	1	R691	7	R753	8	R1495	13
C697	7	J30	1	R35	1	R693	7	R754	8		
C698	7	J80	1	R36	1	R694	7	R755	8	S701	7
C699	7	J90	1	R37	1	R695	7	R756	8		
C701	7	J701	7	R38	1	R696	7	R757	8	U30	1
C702	7	J1010	7	R39	1	R698	7	R759	8	U80	1
C703	7	J1304A	8	R41	1	R699	7	R760	8	U83	1
C704	7	J1400	13	R42	1	R700	7	R761	8	U715	7
C705	7			R53	1	R701	7	R762	8	U745	8
C706	7	L93	1	R55	1	R702	7	R763	8	U755	8
C707	7	L96	1	R56	1	R703	7	R767	8	U1400	13
C708	7	L712	7	R57	1	R704	7	R768	8	U1402	13
C709	7	L713	7	R58	1	R705	7	R769	8	U1404	13
C712	7			R59	1	R706	7	R770	8		
C713	7	Q13A	1	R63	1	R707	7	R771	8	VR719	7
C714	8	Q13B	1	R64	1	R708	7	R772	8		
C715	7	Q63A	1	R65	1	R709	7	R773	8	W1401	1
C722	7	Q63B	1	R72	1	R711	8	R774	8	W1451	1
C723	7	Q680	7								

ATTENUATORS AND PARAPHASE AMPLIFIERS DIAGRAM 1

Assembly A2

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
AT1B	3F	6B	CR18	2D	5A	R29	2D	5B	R89	5E	3D
AT51B	5F	6C	CR57	3C	5C	R30	2D	4B	R90	5E	3D
			CR68	4D	5C	R31	2D	4A	R91	5F	4C
C6	1C	BKBD				R32	2C	3B	R92	5E	3C
C8	1D	6B	E90	1B	2A	R33	2C	3A	R93	1B	1B
C13	1C	6B	E91	1B	1B	R35	3E	4B	R94	5E	3C
C15	2D	BKBD	E92	3B	1B	R36	1E	5B	R96	3B	1B
C29	2E	5B	E93	3B	2B	R37	2F	3B	R1401	2B	2B
C30	2D	4A				R38	2F	4B	R1402	2B	2B
C31	2D	4A	J7	5A	3D	R39	3F	3B	R1403	2B	2B
C32	1G	3B	J30	1H	4A	R41	3F	4B	R1404	2B	2B
C33	2G	3B	J80	3H	4C	R42	3E	3B	R1405	3G	3C
C35	3E	3B	J90	1A	1C	R53	3A	6D	R1433	2G	3B
C38	3F	3B				R55	3B	BKBD	R1434	2G	3C
C56	3C	BKBD	L93	1B	1B	R56	3C	BKBD	R1451	4B	2D
C58	3D	6C	L96	3B	1B	R57	3C	5C	R1452	4B	2C
C63	3C	6C				R58	3D	6C	R1453	4B	2C
C65	4D	BKBD	Q13A	1D	6B	R59	3D	6C	R1454	5B	2C
C79	4E	5C	Q13B	2D	6B	R63	3D	6C	R1455	5F	3D
C80	4C	4C	Q63A	3C	6C	R64	4D	5C	R1483	4G	3C
C81	4D	4C	Q63B	4C	6C	R65	4D	5C	R1484	4G	3C
C82	3G	3D				R72	4D	5D	R1489	5F	3D
C83	5G	3C	R3	1A	6B	R73	4D	5C	R1490	5F	2C
C85	5E	3C	R5	1B	BKBD	R78	4C	3D			
C88	5E	3C	R6	1C	BKBD	R79	4E	5C	U30	1E	4B
C93	1B	1B	R7	1C	5B	R80	4C	4C	U80	3E	4D
C94	1B	2B	R8	1D	6B	R81	4D	4C	U83A	4F	3B
C95	1B	2B	R9	1D	6A	R82	4C	3C	U83B	4F	3B
C96	3B	2B	R13	1D	6B	R83	4C	3C	U83C	2E	3B
C97	3B	3B	R14	1D	5A	R85	5E	4C	U83D	2F	3B
C98	3B	3B	R15	2D	5B	R86	3E	5C			
			R22	2D	5B	R87	4F	2B	W1401	2A	2B
CR7	1C	5B	R23	2D	5B	R88	5F	4C	W1451	4A	2C

Partial A2 also shown on diagrams 7, 8 and 13.



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ATTENUATORS AND PARAPHASE AMPLIFIERS

OTHER PARTS

CIRCUIT NUMBER	SCHEM NUMBER	SCHEM LOCATION	CIRCUIT NUMBER	SCHEM NUMBER	SCHEM LOCATION	CIRCUIT NUMBER	SCHEM NUMBER	SCHEM LOCATION
B1	11	3G	J151	10	5G	J7500	30	3B
DL224	2	3C	J300	10	2G	T901	11	1B
J100	10	1G	J590	6	2H			

TEST WAVEFORM AND VOLTAGE SETUPS

WAVEFORM MEASUREMENTS

The test waveforms associated with the schematic diagrams are intended to aid in troubleshooting the instrument. To test the instrument for these waveforms use the control settings given here as the initial setup. Other settings required for the 2201 are given either preceding each waveform set or with each waveform illustration.

Control settings for the test oscilloscope are shown in the waveform illustrations. Some settings not available in the waveform illustration are given near the illustrations.

Initial 2201 Control Settings

Vertical (Both Channels)

POSITION	Midrange
MODE	CH1, NORM
VOLTS/DIV	10 mV
VOLTS/DIV Var	in CAL detent
Input Coupling	GND

Horizontal

POSITION (both)	Midrange
MAG	X1
SEC/DIV	0.5 ms
SEC/DIV Var	In CAL detent

Trigger

SOURCE	VERT MODE
MODE	P-P AUTO
SLOPE	Positive

Storage Controls

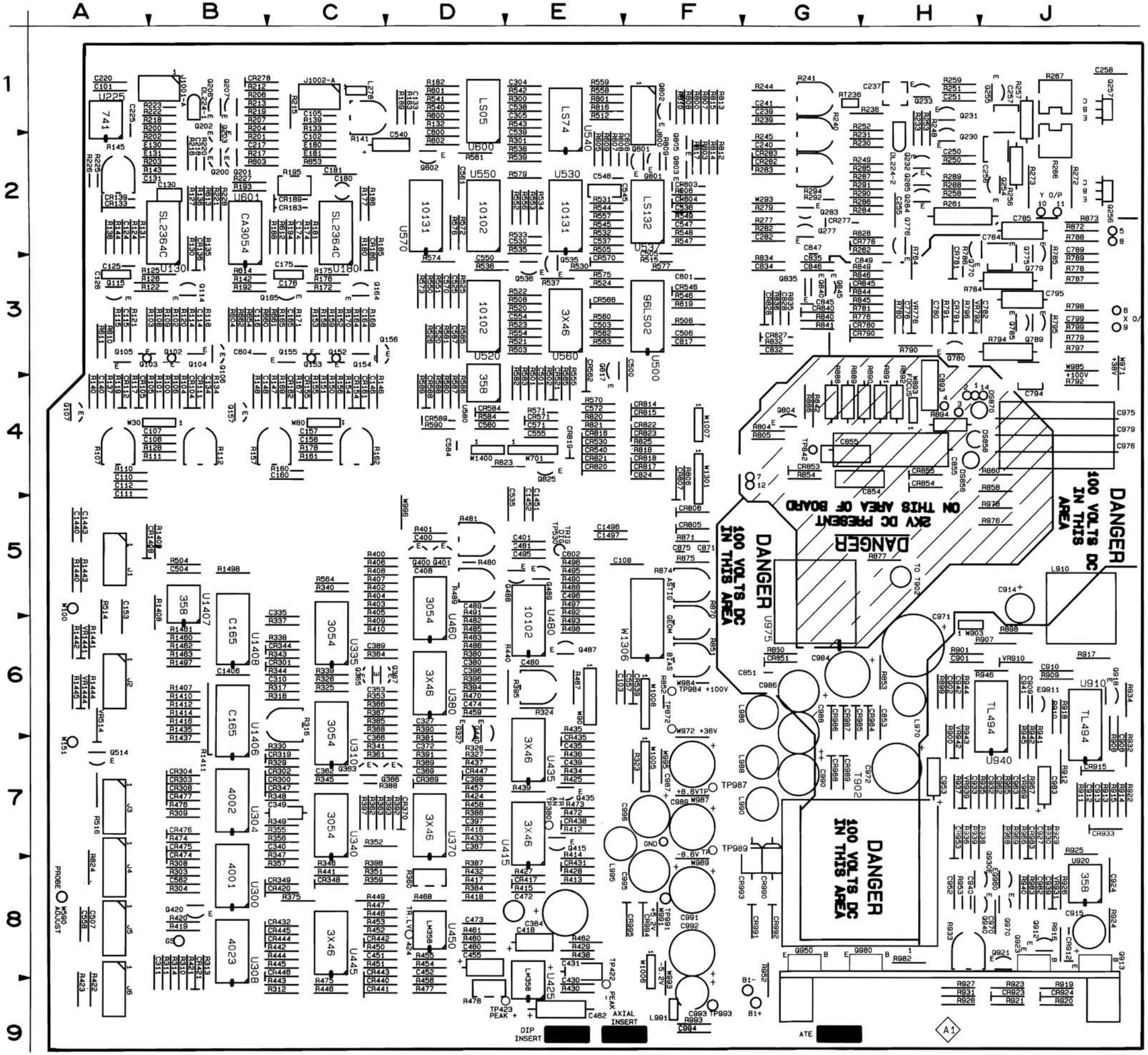
ACQ	CONTINUE
PRE-TRIG	0%
STORE/NON-STORE	NON-STORE

DC VOLTAGE MEASUREMENT

Typical voltage measurements located on the schematic diagrams were obtained under the conditions specified in the Waveform Measurements setup. Control-setting changes required for specific voltages are given on each waveform page.

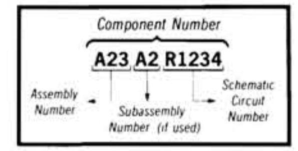
RECOMMENDED TEST EQUIPMENT

Test equipment in Table 4-1 in the Performance Check Procedure, Section 4, of this manual meets the required specifications for testing this instrument.



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List

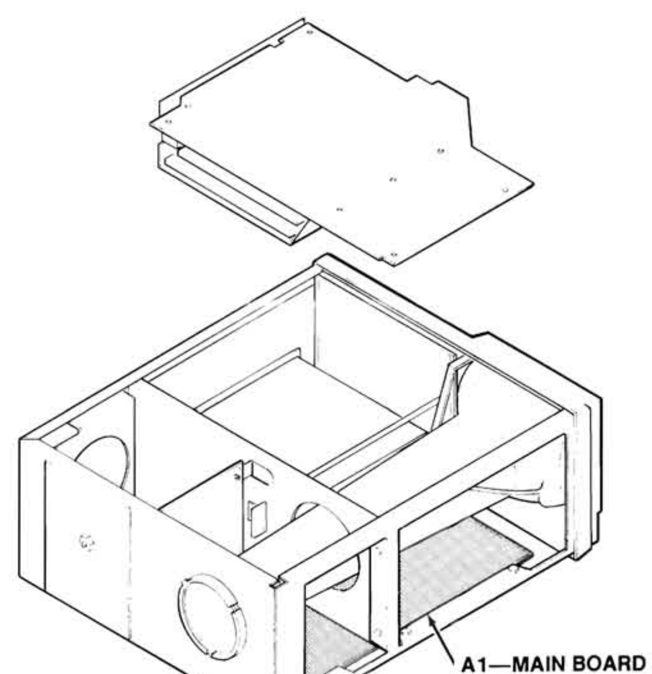


Figure 9-6. A1—Main board component view.

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A1—MAIN BD. COMPONENT VIEW
FIG. 9-6

A1—MAIN BOARD

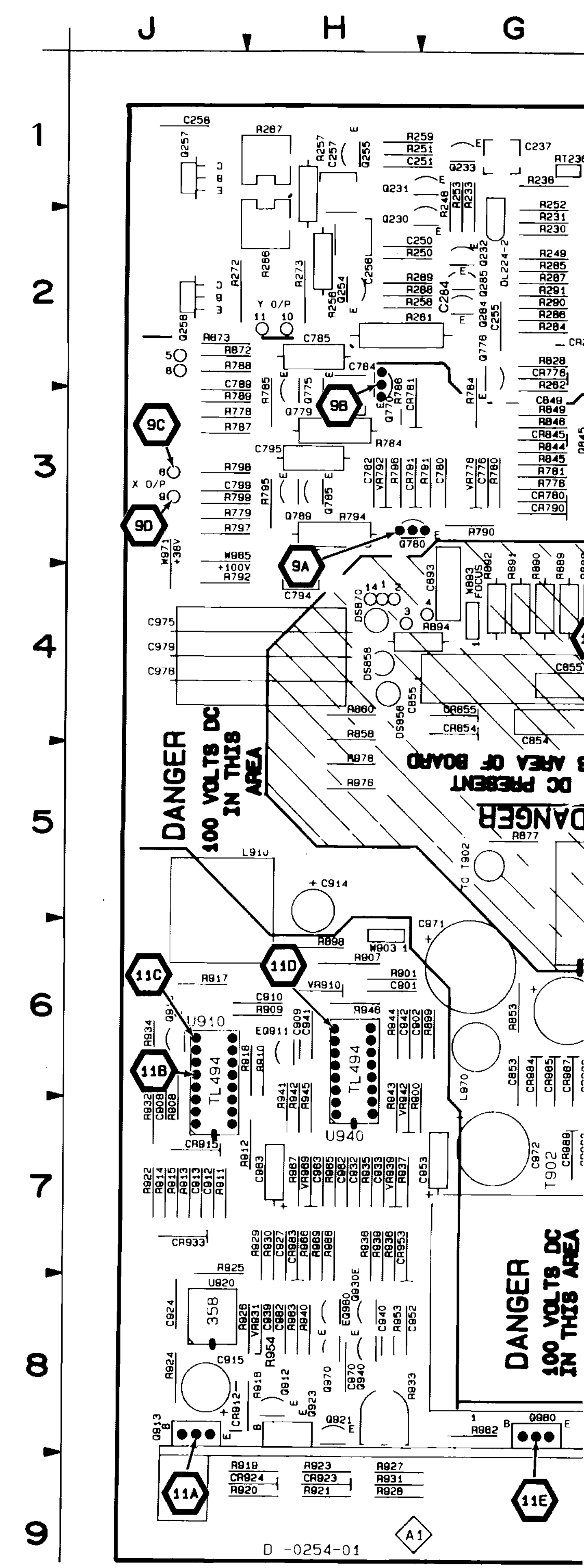
CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
C101	2	C451	4	C908	11	CR349	4	CR993	11	Q488	5
C102	2	C452	4	C909	11	CR369	4	CR994	11	Q489	5
C103	2	C455	4	C910	11	CR370	4	CR995	11	Q514	6
C105	2	C460	4	C912	11	CR417	4	CR1408	12	Q535	6
C106	2	C462	4	C913	11	CR420	4			Q536	6
C107	2	C472	4	C914	11	CR421	4	DS856	12	Q601	2
C108	2	C473	4	C915	11	CR431	4	DS858	12	Q602	2
C110	2	C474	4	C924	11	CR432	4	DS870	12	Q770	9
C111	2	C480	4	C927	11	CR435	4			Q775	9
C112	2	C481	5	C932	11	CR438	4	E102	2	Q776	9
C114	2	C489	5	C933	11	CR440	4	E103	2	Q779	9
C115	2	C495	5	C939	11	CR441	4	E130	2	Q780	9
C116	2	C496	5	C940	11	CR442	4	E131	2	Q785	9
C124	2	C500	6	C941	11	CR443	4	E152	2	Q789	9
C125	2	C501	6	C942	11	CR444	4	E153	2	Q801	12
C126	2	C503	6	C952	11	CR445	4	E180	2	Q802	12
C130	2	C504	6	C953	11	CR446	4	E181	2	Q803	12
C131	2	C505	6	C962	11	CR447	4			Q804	12
C133	2	C506	6	C963	11	CR474	5	J1	14	Q805	12
C134	4	C507	6	C970	11	CR475	5	J3	14	Q817	12
C140	4	C520	6	C971	11	CR476	5	J4	14	Q825	12
C146	4	C525	6	C972	11	CR477	5	J5	14	Q835	12
C148	4	C530	6	C975	12	CR521	6	J6	14	Q840	12
C153	2	C535	13	C976	12	CR530	6	J800	12	Q845	12
C156	2	C536	2	C979	12	CR539	2	J1001	2	Q911	11
C157	2	C537	2	C982	11	CR540	6	J1002	2	Q912	11
C160	2	C538	2	C983	11	CR546	2			Q913	11
C164	2	C539	2	C984	11	CR562	6	L278	3	Q918	11
C165	2	C540	6	C986	11	CR566	6	L910	11	Q921	11
C174	2	C545	2	C987	11	CR570	6	L970	11	Q923	11
C175	2	C546	2	C988	11	CR571	6	L986	11	Q930	11
C176	2	C547	2	C989	11	CR584	6	L988	11	Q940	11
C180	2	C550	6	C990	11	CR588	6	L990	11	Q950	11
C181	2	C554	6	C991	11	CR589	6	L991	11	Q960	11
C182	2	C555	6	C992	11	CR603	2	L995	11	Q970	11
C216	3	C557	6	C993	11	CR604	2			Q980	11
C217	3	C558	6	C994	11	CR776	9	Q102	2		
C220	3	C560	6	C995	11	CR780	9	Q103	2	R100	2
C225	3	C561	2	C996	11	CR781	9	Q104	2	R101	2
C237	3	C562	2	C1052	2	CR790	9	Q105	2	R102	2
C239	3	C570	6	C1053	2	CR791	9	Q114	2	R103	2
C240	3	C571	6	C1059	12	CR805	12	Q115	2	R104	2
C241	3	C572	6	C1406	13	CR806	12	Q152	2	R105	2
C250	3	C584	6	C1440	3	CR807	12	Q153	2	R106	2
C251	3	C587	6	C1443	3	CR814	12	Q154	2	R107	2
C255	3	C600	2	C1451	3	CR815	12	Q155	2	R108	2
C256	3	C601	2	C1452	3	CR816	12	Q164	2	R109	2
C257	3	C602	13	C1496	13	CR817	12	Q165	2	R110	2
C258	3	C604	2	C1497	13	CR818	12	Q200	3	R111	2
C282	3	C608	2			CR819	12	Q201	3	R112	2
C284	3	C776	9	CR104	2	CR820	12	Q202	3	R114	2
C310	4	C780	9	CR105	2	CR821	12	Q203	3	R115	2
C311	5	C782	9	CR111	2	CR822	12	Q206	3	R117	2
C323	4	C784	9	CR112	2	CR823	12	Q207	3	R118	2
C327	4	C785	9	CR133	2	CR827	12	Q230	3	R119	2
C335	4	C789	9	CR136	2	CR828	12	Q231	3	R120	2
C340	4	C794	9	CR139	2	CR840	12	Q232	3	R121	2
C349	4	C795	9	CR154	2	CR845	12	Q233	3	R122	2
C353	4	C799	9	CR155	2	CR851	12	Q254	3	R124	2
C362	4	C817	12	CR161	2	CR853	12	Q255	3	R125	2
C366	4	C824	12	CR162	2	CR854	12	Q256	3	R126	2
C369	4	C828	12	CR183	2	CR855	12	Q257	3	R127	2
C372	4	C832	12	CR186	2	CR912	11	Q277	3	R128	2
C380	4	C834	12	CR189	2	CR915	11	Q283	3	R130	2
C384	4	C835	12	CR277	3	CR923	11	Q284	3	R131	2
C387	4	C845	12	CR278	3	CR924	11	Q285	3	R132	2
C389	4	C846	12	CR282	3	CR933	11	Q327	4	R133	2
C396	4	C847	12	CR283	3	CR953	11	Q363	4	R134	4
C397	4	C849	12	CR300	5	CR983	11	Q365	4	R135	2
C398	4	C851	12	CR301	5	CR984	11	Q366	4	R136	2
C400	5	C853	12	CR302	5	CR985	11	Q367	4	R137	4
C401	5	C854	12	CR303	5	CR986	11	Q400	5	R138	2
C408	5	C855	12	CR304	5	CR987	11	Q401	5	R139	2
C418	4	C871	12	CR308	5	CR988	11	Q415	4	R140	4
C430	4	C875	12	CR319	4	CR989	11	Q420	4	R141	2
C431	4	C893	12	CR344	4	CR990	11	Q435	4	R142	2
C435	4	C901	11	CR347	4	CR991	11	Q440	4	R143	2
C439	4	C902	11	CR348	4	CR992	11	Q487	5	R144	2

A1 – MAIN BOARD (cont)

CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
R145	2	R251	3	R369	4	R468	4	R564	6	R816	12
R146	4	R252	3	R375	4	R470	4	R565	6	R817	12
R147	4	R253	3	R380	4	R472	4	R570	6	R818	12
R148	4	R254	3	R381	4	R473	4	R571	6	R819	12
R150	2	R255	3	R384	4	R474	5	R572	6	R820	12
R151	2	R256	3	R385	4	R475	4	R573	6	R821	12
R152	2	R257	3	R386	4	R476	5	R574	6	R823	12
R153	2	R258	3	R387	4	R477	4	R575	6	R824	12
R154	2	R259	3	R388	4	R478	4	R576	6	R825	12
R155	2	R261	3	R390	4	R480	5	R577	6	R828	9
R156	2	R262	9	R391	4	R481	5	R579	6	R832	12
R157	2	R266	3	R392	4	R482	5	R580	6	R834	12
R158	2	R267	3	R393	4	R483	5	R581	6	R835	12
R159	2	R272	3	R394	4	R485	5	R582	6	R836	12
R160	2	R273	3	R395	4	R486	5	R583	6	R840	12
R161	2	R277	3	R396	4	R487	5	R584	6	R841	12
R162	2	R279	3	R397	4	R488	5	R585	6	R842	12
R164	2	R282	3	R398	4	R489	5	R586	6	R844	12
R165	2	R283	3	R400	5	R490	5	R587	6	R845	12
R167	2	R284	3	R401	5	R491	5	R588	6	R846	12
R168	2	R285	3	R402	5	R492	5	R589	6	R849	12
R169	2	R286	3	R403	5	R493	5	R590	6	R850	12
R170	2	R287	3	R404	5	R495	5	R600	2	R851	12
R171	2	R288	3	R405	5	R496	5	R601	2	R852	12
R172	2	R289	3	R406	5	R497	5	R602	2	R853	12
R174	2	R290	3	R407	5	R498	5	R603	2	R854	12
R175	2	R291	3	R408	5	R501	6	R604	2	R858	12
R176	2	R292	3	R409	5	R502	6	R605	2	R860	12
R177	2	R294	3	R410	5	R503	6	R606	2	R870	12
R178	2	R300	5	R412	4	R504	6	R607	2	R871	12
R180	2	R301	5	R413	4	R505	6	R608	2	R872	12
R181	2	R303	5	R414	4	R506	6	R609	2	R873	12
R182	2	R304	5	R415	4	R508	6	R610	2	R874	12
R183	2	R308	5	R416	4	R512	6	R611	2	R875	12
R185	2	R309	5	R417	4	R514	6	R612	2	R877	11
R186	2	R310	5	R418	4	R515	6	R613	2	R886	12
R188	2	R311	5	R419	4	R516	6	R614	2	R888	12
R189	2	R312	5	R420	4	R520	6	R653	2	R889	12
R192	2	R313	5	R421	4	R521	6	R654	2	R890	12
R193	2	R314	5	R422	4	R522	6	R660	2	R891	12
R194	2	R316	4	R423	4	R523	6	R661	2	R892	12
R195	2	R317	4	R424	4	R524	6	R662	2	R894	12
R200	3	R318	4	R425	4	R525	6	R764	9	R898	11
R201	3	R323	4	R427	4	R526	6	R776	9	R899	11
R202	3	R324	4	R428	4	R530	6	R778	9	R900	11
R203	3	R325	4	R429	4	R531	6	R779	9	R901	11
R204	3	R326	4	R430	4	R532	6	R780	9	R907	11
R206	3	R327	4	R432	4	R533	6	R781	9	R908	11
R207	3	R328	4	R433	4	R534	6	R784	9	R909	11
R212	3	R329	4	R434	4	R535	6	R785	9	R910	11
R213	3	R330	4	R435	4	R536	6	R786	9	R911	11
R215	3	R337	4	R436	4	R537	6	R787	9	R912	11
R216	3	R338	4	R437	4	R538	2	R788	9	R913	11
R217	3	R339	4	R438	4	R539	2	R789	9	R914	11
R218	3	R340	4	R439	4	R540	2	R790	9	R915	11
R219	3	R341	4	R440	4	R541	2	R791	9	R916	11
R220	3	R343	4	R441	4	R542	2	R792	9	R917	11
R221	3	R344	4	R442	4	R543	2	R794	9	R918	11
R222	3	R345	4	R443	4	R544	2	R795	9	R919	11
R223	3	R346	4	R444	4	R545	2	R796	9	R920	11
R224	3	R347	4	R445	4	R546	2	R797	9	R921	11
R225	3	R348	4	R446	4	R547	2	R798	9	R922	11
R226	3	R349	4	R447	4	R548	2	R799	9	R923	11
R227	3	R351	4	R448	4	R549	2	R800	12	R924	11
R228	3	R352	4	R449	4	R550	6	R801	12	R925	11
R229	3	R353	4	R450	4	R551	6	R803	12	R926	11
R230	3	R355	4	R451	4	R552	6	R804	12	R927	11
R231	3	R356	4	R452	4	R553	6	R805	12	R928	11
R233	3	R357	4	R453	4	R554	6	R806	12	R929	11
R236	3	R359	4	R454	4	R555	6	R807	12	R930	11
R239	3	R360	4	R455	4	R556	6	R808	12	R931	11
R240	3	R361	4	R456	4	R557	6	R809	12	R932	11
R241	3	R362	4	R457	4	R558	2	R810	12	R933	11
R244	3	R363	4	R458	4	R559	2	R811	12	R934	11
R245	3	R364	4	R459	4	R560	6	R812	12	R935	11
R248	3	R366	4	R460	4	R561	2	R813	12	R936	11
R249	3	R367	4	R461	4	R562	6	R814	12	R937	11
R250	3	R368	4	R462	4	R563	6	R815	12	R938	11

A1 – MAIN BOARD (cont)

CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
R939	11			U975	12
R940	11	T902	11	U1406	13
R941	11			U1407	12
R942	11	TP380	4	U1408	13
R943	11	TP422	4		
R944	11	TP423	4	VR514	6
R945	11	TP530	5	VR776	9
R946	11	TP842	12	VR792	9
R952	11	TP872	11	VR910	11
R953	11	TP984	11	VR931	11
R954	11	TP987	11	VR939	11
R965	11	TP989	11	VR942	11
R966	11	TP991	11	VR969	11
R967	11	TP993	11	VR1441	3
R968	11			VR1444	3
R969	11	U130	2		
R976	12	U180	2		
R978	12	U225	3	W30	2
R982	11	U300	5	W80	2
R983	11	U304	5	W90	11
R993	11	U308	5	W100	3
R1407	12	U310	4	W151	3
R1408	12	U335	4	W293	3
R1409	12	U340	4	W590	6
R1410	5	U370	4	W701	6
R1411	5	U380	4	W893	12
R1411	12	U415	4	W903	11
R1411	13	U425	4	W971	11
R1412	5	U435	4	W972	11
R1414	5	U445	4	W984	11
R1416	5	U450	4	W985	11
R1435	5	U460	5	W987	11
R1437	5	U480	5	W989	11
R1440	3	U500	6	W991	11
R1441	3	U520	6	W993	11
R1442	3	U530	6	W995	11
R1443	3	U537	2	W996	14
R1444	3	U540	2	W1005	2
R1445	3	U550	6	W1005	3
R1460	13	U560	6	W1006	11
R1461	13	U570	6	W1007	13
R1462	13	U580	6	W1008	2
R1463	13	U600	2	W1008	6
R1497	13	U601	2	W1008	12
R1498	13	U910	11	W1301	9
		U920	11	W1306	2
RT236	3	U940	11	W1400	13



A1—MAIN BOARD (cont)

CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
R939	11			U975	12
R940	11	T902	11	U1406	13
R941	11			U1407	12
R942	11	TP380	4	U1408	13
R943	11	TP422	4		
R944	11	TP423	4	VR514	6
R945	11	TP530	5	VR776	9
R946	11	TP842	12	VR792	9
R952	11	TP872	11	VR910	11
R953	11	TP984	11	VR931	11
R954	11	TP987	11	VR939	11
R965	11	TP989	11	VR942	11
R966	11	TP991	11	VR969	11
R967	11	TP993	11	VR1441	3
R968	11			VR1444	3
R969	11	U130	2		
R976	12	U180	2	W30	2
R978	12	U225	3	W80	2
R982	11	U300	5	W90	11
R983	11	U304	5	W100	3
R993	11	U308	5	W151	3
R1407	12	U310	4	W293	3
R1408	12	U335	4	W590	6
R1409	12	U340	4	W701	6
R1410	5	U370	4	W893	12
R1411	5	U380	4	W903	11
R1411	12	U415	4	W971	11
R1411	13	U425	4	W972	11
R1412	5	U435	4	W984	11
R1414	5	U445	4	W985	11
R1416	5	U450	4	W987	11
R1435	5	U460	5	W989	11
R1437	5	U480	5	W991	11
R1440	3	U500	6	W993	11
R1441	3	U520	6	W995	11
R1442	3	U530	6	W996	14
R1443	3	U537	2	W1005	2
R1444	3	U540	2	W1005	3
R1445	3	U550	6	W1006	11
R1460	13	U560	6	W1007	13
R1461	13	U570	6	W1008	2
R1462	13	U580	6	W1008	6
R1463	13	U600	2	W1008	12
R1497	13	U601	2	W1301	9
R1498	13	U910	11	W1306	2
		U920	11	W1400	13
RT236	3	U940	11		

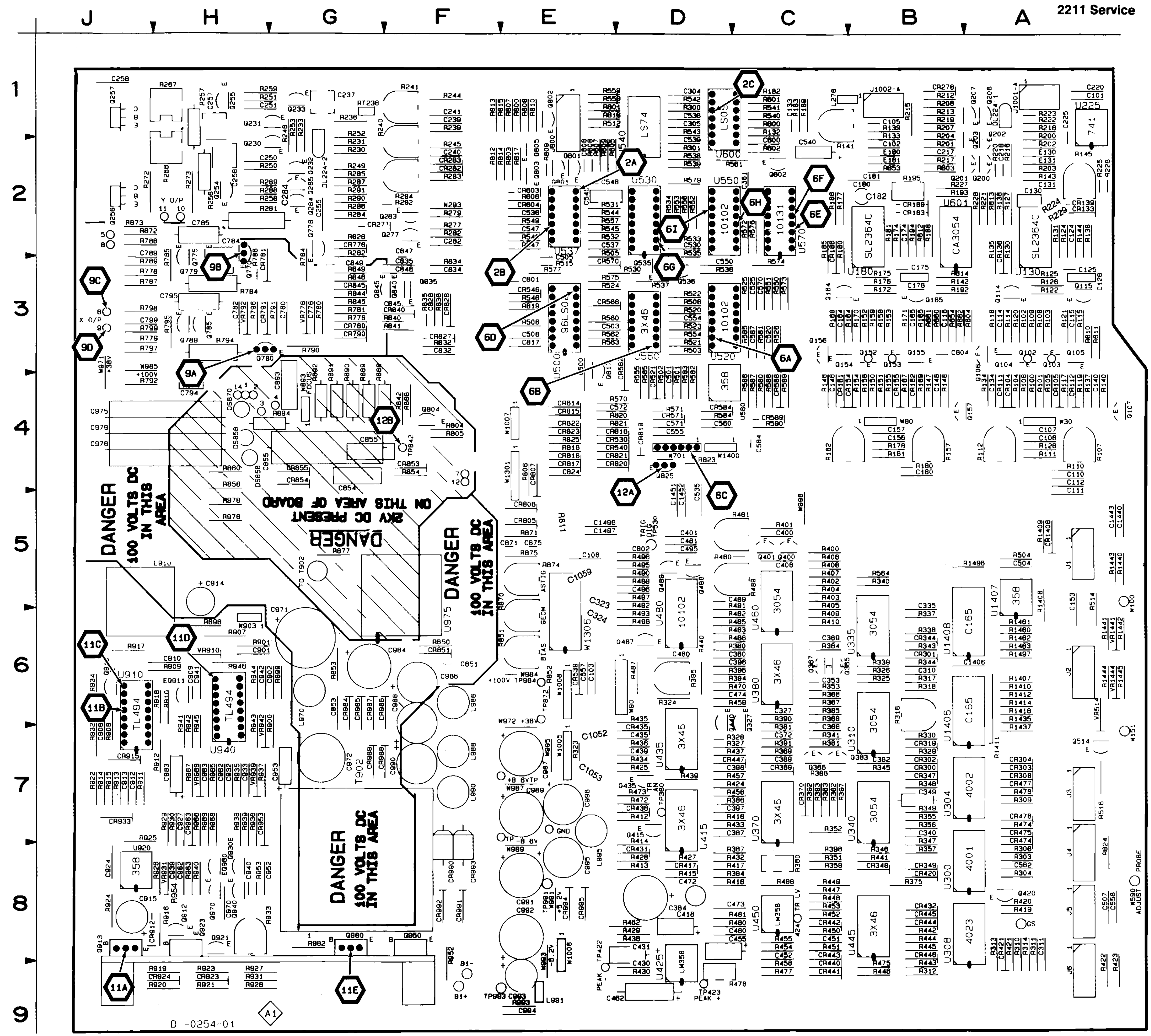


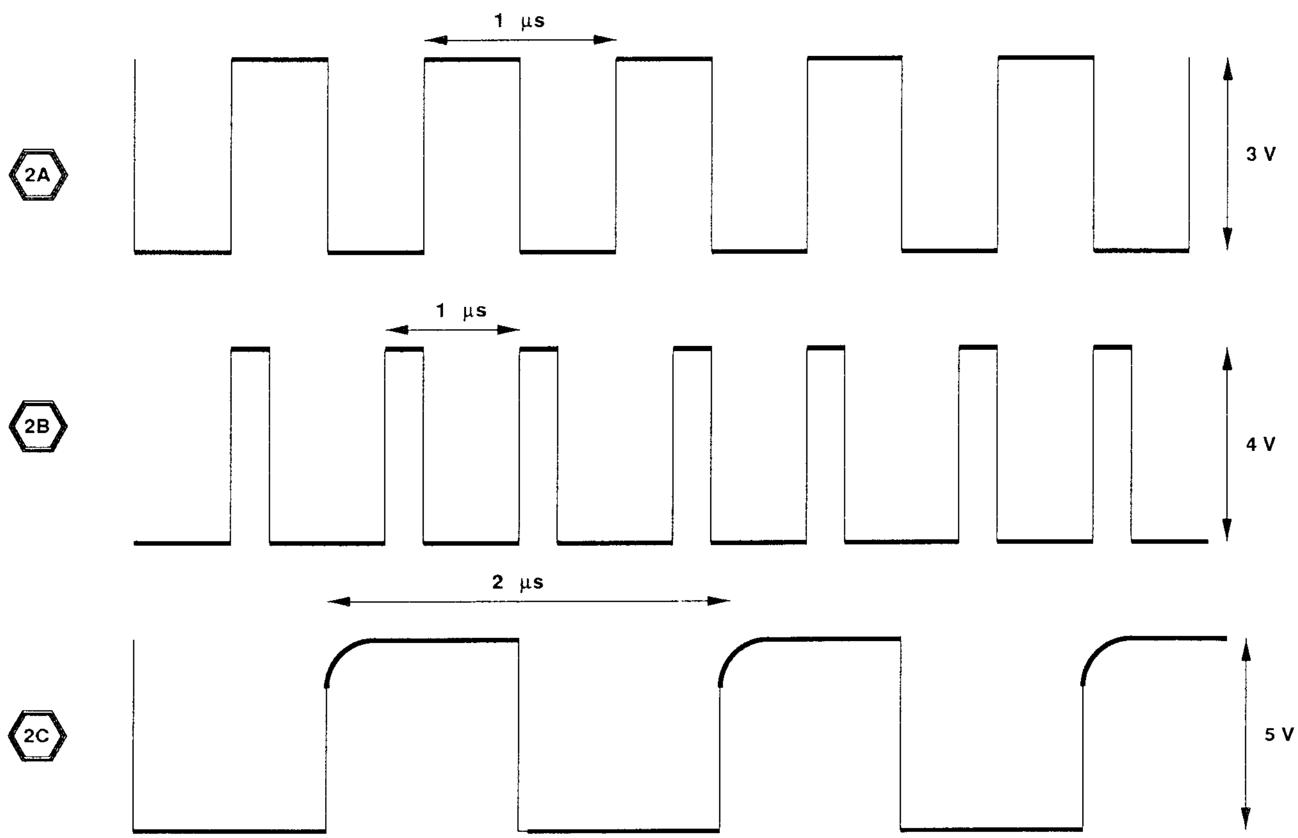
Figure 9-7. A1—Main board circuit view.

7234-83

WAVEFORMS FOR DIAGRAM 2

2211 CONTROL SETTINGS

DC VOLTAGES		AC WAVEFORMS	
AC-GND-DC (BOTH)	GND	VERTICAL MODE	BOTH, CHOP
VOLTS/DIV (BOTH)	0.1 V	TRIGGER MODE	P-P AUTO
STORE/NON-STORE	NON-STORE	STORE/NON-STORE	NON-STORE



7234-84

VERTICAL PREAMPLIFIER DIAGRAM 2

Assembly A1

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C101	1H	1A
C102	5H	2C
C103	3H	6E
C105	5H	1C
C106	1B	4B
C107	2A	4B
C108	4H	5E
C110	1B	4A
C111	2C	4A
C112	1C	4A
C114	1C	3B
C115	2C	3A
C116	1C	3B
C124	2D	2A
C125	2D	3A
C126	2D	3A
C130	1E	2B
C131	1E	2B
C133	3E	1D
C153	5C	5A
C156	4B	4C
C157	5B	4C
C160	5B	4C
C164	5C	3C
C165	5C	3C
C174	5D	2C
C175	5D	3C
C176	5D	3C
C180	5E	2C
C181	5E	2C
C182	5E	4C
C536	3C	2F
C537	5A	2E
C538	3C	1E
C539	4C	1E
C545	3B	2F
C546	3B	2E
C547	3C	2F
C561	3A	2D
C562	3A	8B
C600	5B	1D
C601	2D	3F
C604	2H	3B
C608	3D	2F
C1052	3B	BKBD
C1053	4B	BKBD
CR104	1B	4B
CR105	2B	4A
CR111	1B	4B
CR112	2B	4A
CR133	1F	2A
CR136	2E	2B
CR139	1F	2A
CR154	5B	4C
CR155	5B	4C
CR161	4B	4C

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
CR162	5B	4C
CR183	5F	2C
CR186	4E	2C
CR189	5F	2C
CR539	4A	6F
CR546	3B	3F
CR603	2D	2F
CR604	2D	2F
E102	1B	3B
E103	1B	3B
E130	1F	2B
E131	1F	2B
E152	5B	3C
E153	5B	3C
E180	5F	2C
E181	5F	2C
J1001	1H	1B
J1002	1H	1C
Q102	1A	3B
Q103	2A	3A
Q104	1C	3B
Q105	2C	3A
Q114	1D	3B
Q115	2D	3A
Q152	4A	3C
Q153	5A	3C
Q154	4C	3C
Q155	5C	3C
Q164	5D	3C
Q165	5D	3C
Q601	2D	2F
Q602	3E	2D
R100	1A	4B
R101	2A	4B
R102	1A	3B
R103	2A	3B
R104	1B	4B
R105	1B	4B
R106	1B	4B
R107	1B	4A
R108	1A	3B
R109	1A	3B
R110	1B	4A
R111	1B	4B
R112	1B	4B
R114	1D	3B
R115	2D	3A
R117	1C	4A
R118	1C	3B
R119	2C	4A
R120	1D	3B
R121	1D	3A
R122	1D	3B

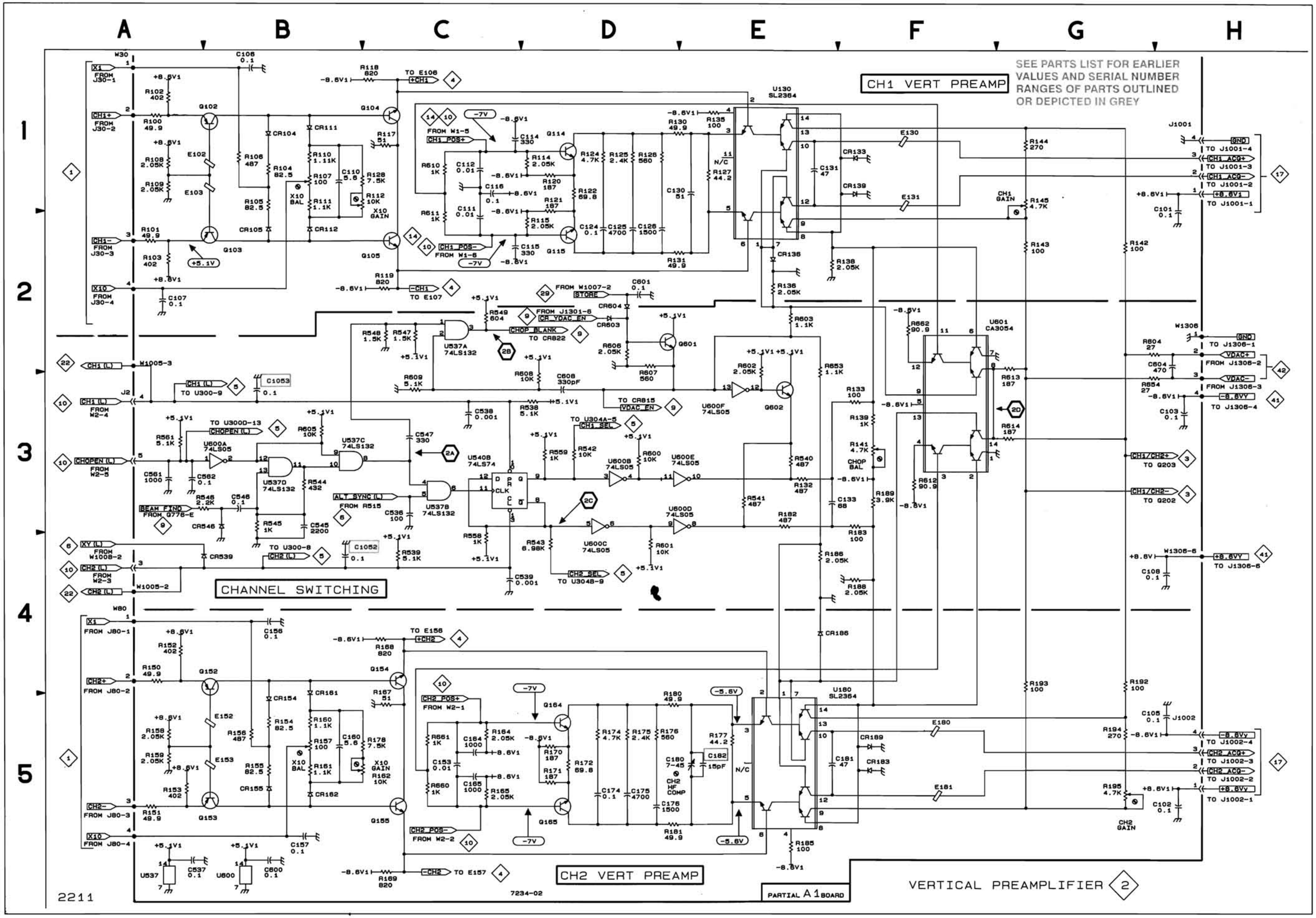
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R124	1D	2A
R125	1D	3B
R126	1D	3B
R127	1E	2B
R128	1B	4B
R130	1D	2B
R131	2D	2A
R132	3E	1D
R133	3F	1C
R135	1E	2B
R136	2E	2B
R138	2E	2A
R139	3F	1C
R141	3F	2C
R142	2G	3B
R143	2G	2B
R144	1G	2A
R145	1G	2A
R150	4A	4C
R151	5A	4C
R152	4A	3C
R153	5A	3C
R154	5B	4C
R155	5B	4C
R156	5B	4C
R157	5B	4B
R158	5A	3C
R159	5A	3C
R160	5B	4C
R161	5B	4C
R162	5B	4C
R164	5C	3C
R165	5C	3C
R167	5C	4C
R168	4C	3C
R169	6C	4C
R170	5D	3C
R171	5D	3C
R172	5D	3C
R174	5D	2C
R175	5D	3C
R176	5D	3C
R177	5E	2C
R178	5B	4C
R180	5D	2C
R181	5D	2C
R182	3E	1D
R183	3F	1D
R185	5E	2C
R186	4E	2C
R188	4F	2C
R189	3F	1D
R192	4G	3B
R193	4G	2B
R194	5G	2C
R195	5G	2C

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R538	3D	2E
R539	4C	2E
R540	3E	1D
R541	3E	1D
R542	3D	1E
R543	4D	1E
R544	3B	2E
R545	3B	2E
R546	3A	3F
R547	2C	2F
R548	2C	2F
R549	2C	2F
R558	4C	1E
R559	3D	1E
R561	3A	2D
R600	3D	1D
R601	4D	1D
R602	2E	2D
R603	2E	2B
R604	2G	3B
R605	3B	2E
R606	2D	2F
R607	2D	2E
R608	3D	2E
R609	3C	2E
R610	1C	3A
R611	2C	3A
R612	3F	2C
R613	2G	2B
R614	3G	3B
R653	2E	2C
R654	3G	3B
R660	5C	3B
R661	5C	3C
R662	2F	3B
U130	1E	3B
U180	5E	3C
U537A	2C	2F
U537B	3C	2F
U537C	3B	2F
U537D	3B	2F
U540B	3C	2E
U600A	3B	2D
U600B	3D	2D
U600C	3D	2D
U600D	3D	2D
U600E	3D	2D
U600F	3E	2D
U601	2F	2B
W30	1A	4A
W80	4A	4C
W1005	2A	7F
W1008	4A	6F
W1306	5H	6F

Partial A1 also shown on diagrams 3, 4, 5, 6, 9, 11, 12, 13 and 14.

OTHER PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DL224	3C	CHASSIS


A
B
C
D
E
F
G
H
1
2
3
4
5
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY
CH1 VERT PREAMP
CHANNEL SWITCHING
CH2 VERT PREAMP
U130 SL2364
U180 SL2364
U601 CA3054
U540B 74LS74
U537A 74LS132
U537B 74LS132
U537C 74LS132
U537D 74LS132
U600A 74LS05
U600B 74LS05
U600C 74LS05
U600D 74LS05
U600E 74LS05
U600F 74LS05
CH1 GAIN
CH2 GAIN
CHOP BAL
CH2 HF COMP
X10 BAL
X10 GAIN
FROM J30-1
FROM J30-2
FROM J30-3
FROM J30-4
FROM J80-1
FROM J80-2
FROM J80-3
FROM J80-4
TO J1001-4
TO J1001-3
TO J1001-2
TO J1001-1
TO J1002-4
TO J1002-3
TO J1002-2
TO J1002-1
TO J1306-1
FROM J1306-2
FROM J1306-3
TO J1306-4
TO J1306-6
TO E106
TO E107
TO E156
TO E157
TO Q203
TO Q202
CHOP BLANK
TO CR822
CR VDAC EN
VDAC EN
TO CR815
STORE
FROM W1007-2
FROM J1301-6
ALT SYNC (L)
FROM R515
BEAM FIND
FROM Q776-E
CHOPEN (L)
FROM W2-5
XY (L)
FROM W1008-2
CH1 SEL
TO U304A-5
CH2 SEL
TO U304B-9
TO U300D-13
TO U300-9
TO U300-8
CH1 POS+
CH1 POS-
FROM W1-5
FROM W1-6
CH2 POS+
CH2 POS-
FROM W2-1
FROM W2-2
7234-02
PARTIAL A1 BOARD
VERTICAL PREAMPLIFIER 2

VERTICAL OUTPUT AMPLIFIER DIAGRAM 3

Assembly A1

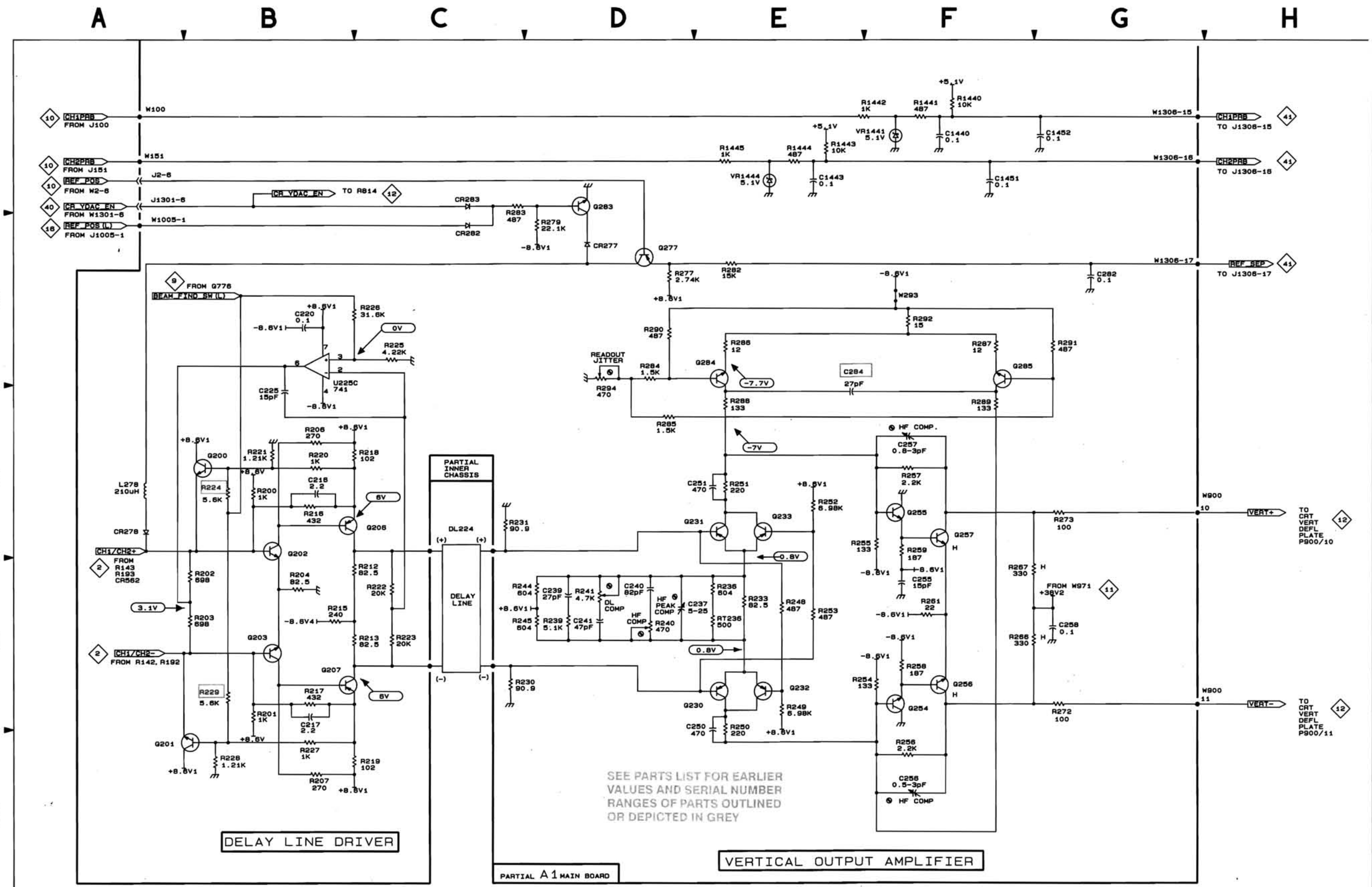
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C216	3B	2B
C217	4B	2B
C220	2B	1A
C225	3B	1A
C237	4D	1H
C239	4D	1G
C240	4D	2G
C241	4D	1G
C250	4E	2H
C251	3E	1H
C255	4F	2H
C256	5F	2J
C257	3F	1J
C258	4G	1J
C282	2G	2G
C284	3E	BKBD
C1440	1F	5A
C1443	1E	5A
C1451	1F	5E
C1452	1G	5E
CR277	2D	2G
CR278	3A	1B
CR282	2C	2G
CR283	1C	2G
L278	3A	1C
Q200	3B	2B
Q201	5A	2B
Q202	3B	1B
Q203	4B	1B
Q206	3B	1B

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
Q207	4B	1B
Q230	4E	2H
Q231	3E	1H
Q232	4E	2H
Q233	3E	1H
Q254	4F	2J
Q255	3F	1J
Q256	4F	2J
Q257	3F	1J
Q277	2D	2G
Q283	1D	2G
Q284	2E	2H
Q285	2F	2H
R200	3B	1B
R201	4B	2B
R202	4B	2B
R203	4B	2B
R204	4B	1B
R206	3B	1B
R207	5B	1B
R212	4B	1B
R213	4B	1B
R215	4B	1C
R216	3B	2B
R217	4B	2B
R218	3B	1B
R219	5B	1B
R220	3B	2B
R221	3B	2B
R222	4C	1B
R223	4C	1B

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R224	3B	BKBD
R225	2C	2A
R226	2B	2A
R227	5B	2B
R228	5B	2B
R229	4B	BKBD
R230	4C	2H
R231	3C	2G
R233	4E	1H
R236	4E	1H
R239	4D	1G
R240	4D	1G
R241	4D	1G
R244	4D	1G
R245	4D	2G
R248	4E	1H
R249	4E	2H
R250	4E	2H
R251	3E	1H
R252	3E	1H
R253	4E	1H
R254	4F	BKBD
R255	3F	BKBD
R256	5F	2J
R257	3F	1J
R258	4F	2H
R259	3F	1H
R261	4F	2H
R266	4F	2J
R267	4F	1J
R272	4G	2J
R273	3G	2J

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R277	2D	2G
R279	2D	2G
R282	2E	2G
R283	1C	2G
R284	2D	2H
R285	3D	2H
R286	2E	2H
R287	2F	2H
R288	3E	2H
R289	3F	2H
R290	2D	2H
R291	2G	2H
R292	2F	2G
R294	2D	2G
R1440	1F	5A
R1441	1F	6A
R1442	1E	6A
R1443	1E	5A
R1444	1E	6A
R1445	1E	6A
RT236	4E	1G
U225C	2B	1A
VR1441	1F	6A
VR1444	1E	6A
W100	1A	5A
W151	1A	7A
W293	2F	2G
W1005	2A	7F

Partial A1 also shown on diagrams 2, 4, 5, 6, 9, 11, 12, 13 and 14.



VERTICAL OUTPUT AMPLIFIER ③

2211

7234-03

VERTICAL OUTPUT AMPLIFIER ③

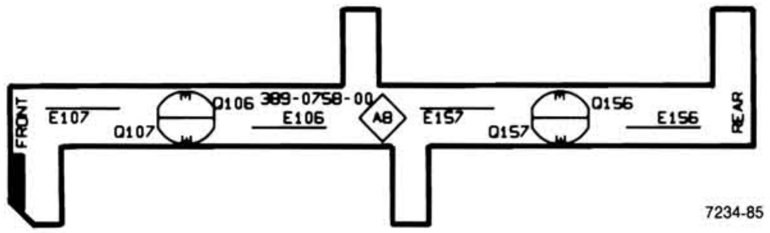
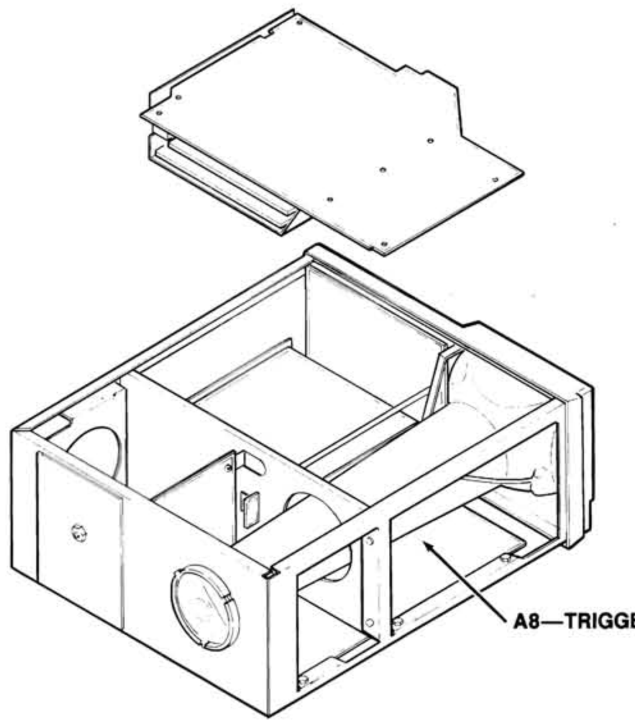


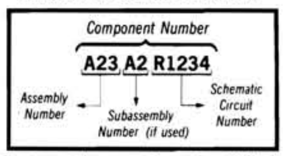
Figure 9-8. A8—Trigger Pickoff board.

A8—TRIGGER PICKOFF BOARD											
CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
E106	4	E156	4	Q106	4	Q156	4				
E107	4	E157	4	Q107	4	Q157	4				



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

A8—TRIGGER PICKOFF BOARD
FIG 9-8

TRIGGER DIAGRAM 4

Assembly A1

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C134	5D	4B
C140	5C	4A
C146	5B	4C
C148	5B	4B
C310	4B	6C
C323	3D	BKBD
C327	1D	6D
C335	3D	5C
C340	3B	7C
C349	3A	7C
C353	1C	6C
C362	2B	7C
C366	1C	7C
C369	2C	7D
C372	2C	7D
C380	3D	6D
C384	3C	8E
C387	3C	7D
C389	2D	6C
C396	2D	6D
C397	3E	7D
C398	3E	7D
C418	1F	8E
C430	2G	9E
C431	3F	8E
C435	2F	7E
C439	2F	7E
C451	4F	8C
C452	4G	8D
C455	4G	8D
C460	4G	8D
C462	5G	9E
C472	4G	8E
C473	3G	8D
C474	3F	6D
C480	5G	6E
CR319	4B	7C
CR344	4C	6C
CR347	2B	7C
CR348	2A	8C
CR349	3A	8C
CR369	2C	7D
CR370	2C	7D
CR417	1E	8E
CR420	5E	8C
CR421	5E	8B
CR431	2F	8E
CR432	5E	8C
CR435	2E	7E
CR438	2F	7E
CR440	4F	9C
CR441	4F	9C
CR442	5F	8C
CR443	4F	8C
CR444	4E	8C
CR445	5E	8C
CR446	4E	8C
CR447	3F	7D

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
Q327	1D	6D
Q363	2B	7C
Q365	2A	6C
Q366	1C	7D
Q367	1C	6D
Q415	1F	7E
Q420	5E	8B
Q435	2E	7E
Q440	5F	6D
R134	5D	4B
R137	5D	4A
R140	5C	4A
R146	5B	4C
R147	5B	4C
R148	5A	4B
R316	5B	6C
R317	4C	6C
R318	4B	6C
R323	3D	7F
R324	3D	6E
R325	4A	6C
R326	4B	6C
R327	3C	7D
R328	3D	7D
R329	4B	7C
R330	4B	7C
R337	5C	6C
R338	5D	6C
R339	4C	6C
R340	4D	5C
R341	1C	7C
R343	4D	6C
R344	4D	6C
R345	2B	7C
R346	2A	8C
R347	3B	7C
R348	3B	7C
R349	3A	7C
R351	3B	8C
R352	3B	7C
R353	1C	6C
R355	3B	7C
R356	3B	7C
R357	3B	8C
R359	3B	8C
R360	3B	8D
R361	2A	7C
R362	2B	7C
R363	1B	7C
R364	1A	6C
R366	1C	6C
R367	1C	6C
R368	1C	6C
R369	2C	7D
R375	5E	8C
R380	1E	6D
R381	2D	7D
R384	3C	8D
R385	3D	6C

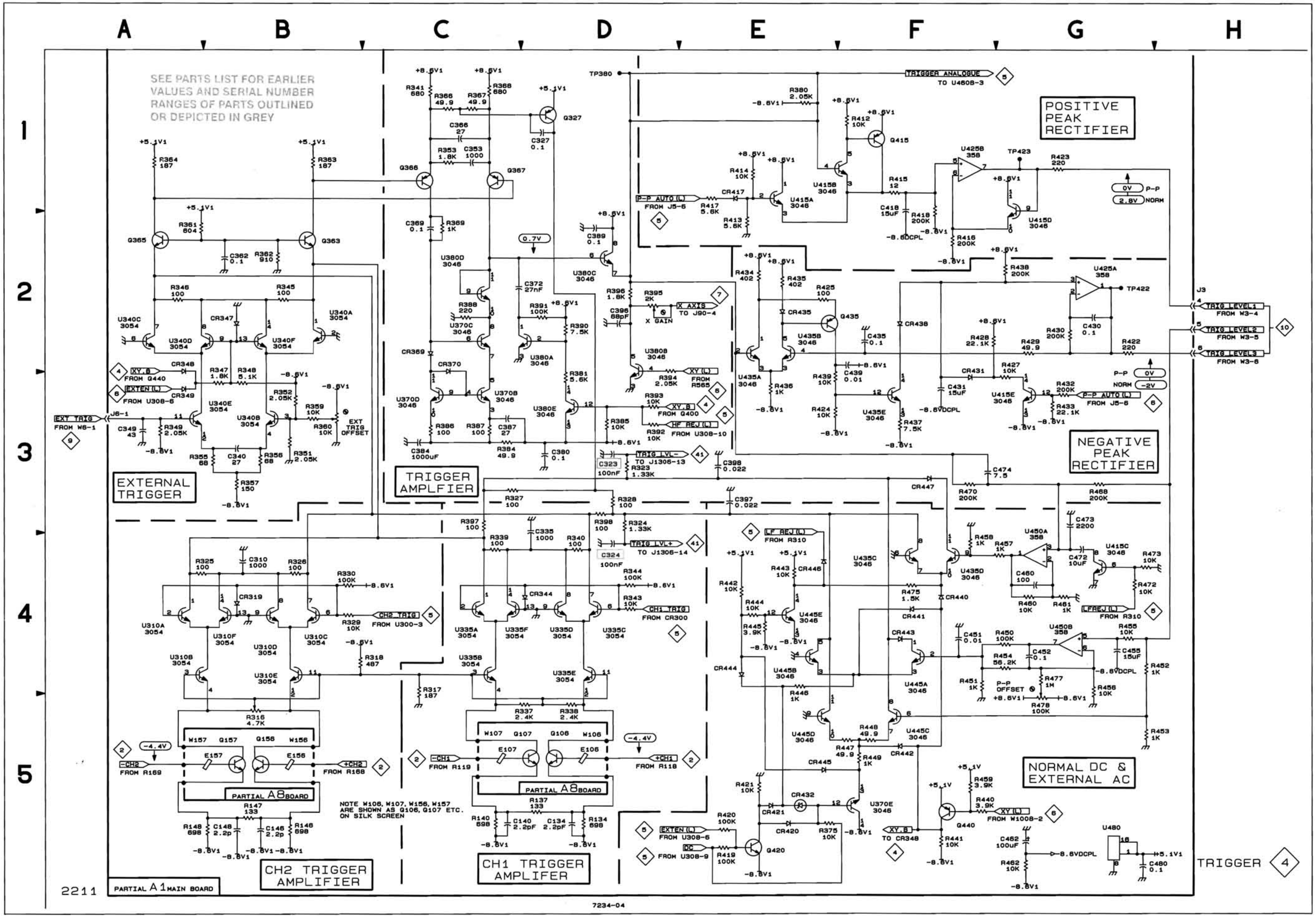
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R386	3C	7D
R387	3C	8D
R388	2C	7C
R390	2D	6D
R391	2D	7D
R392	3D	7D
R393	3D	7D
R394	2D	6D
R395	2D	6E
R396	2D	6D
R397	3C	7C
R398	3D	8C
R412	1F	7E
R413	2E	8E
R414	1E	7E
R415	1F	8E
R416	2F	7D
R417	1E	8D
R418	1F	8D
R419	5E	8B
R420	5E	8B
R421	5E	8B
R422	2G	9A
R423	1G	8A
R424	3E	7D
R425	2E	7E
R427	2G	8E
R428	2F	8E
R429	2G	8E
R430	2G	9E
R432	3G	8D
R433	3G	7D
R434	2E	7E
R435	2E	6E
R436	3E	7E
R437	3F	7D
R438	2G	8E
R439	2E	7E
R440	5F	6E
R441	5F	8C
R442	4E	8C
R443	4E	9C
R444	4E	8C
R445	4E	8C
R446	4E	9C
R447	5F	8C
R448	5F	8C
R449	5F	8C
R450	4G	8C
R451	4F	8C
R452	4G	8C
R453	5G	8C
R454	4G	8D
R455	4G	8D
R456	4G	9E
R457	4F	7D
R458	4F	7D
R459	5F	6D
R460	4G	8D
R461	4G	8D

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R462	5G	8E
R468	3G	8D
R470	3F	6D
R472	4G	7E
R473	4G	7E
R475	4F	9C
R477	4G	9E
R478	4G	9E
TP380	1D	7E
TP422	2G	8E
TP423	1G	9E
U310A	4A	7C
U310B	4A	7C
U310C	4B	7C
U310D	4B	7C
U310E	4B	7C
U310F	4B	7C
U335A	4C	6C
U335B	4C	6C
U335C	4D	6C
U335D	4D	6C
U335E	4D	6C
U335F	4C	6C
U340A	2B	7C
U340B	3B	7C
U340C	2A	7C
U340D	2A	7C
U340E	3A	7C
U340F	2B	7C
U370B	3C	7D
U370C	2C	7D
U370D	3C	7D
U370E	5F	7D
U380A	2C	6D
U380B	2D	6D
U380C	2D	6D
U380D	2C	6D
U380E	3D	6D
U415A	1E	7E
U415B	1E	7E
U415C	4G	7E
U415D	1G	7E
U415E	3G	7E
U425A	2G	9E
U425B	1F	9E
U435A	2E	7E
U435B	2E	7E
U435C	4F	7E
U435D	4F	7E
U435E	3F	7E
U445A	4F	8C
U445B	4E	8C
U445C	5F	8C
U445D	5E	8C
U445E	4E	8C
U450A	4G	8D
U450B	4G	8D

Partial A1 also shown on diagrams 2, 3, 5, 6, 9, 11, 12, 13 and 14.

Assembly A8

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
E106	5D	1A	E157	5A	1A	Q106	5D	1A	Q156	5B	1A
E107	5C	1A				Q107	5C	1A	Q157	5B	1A
E156	5B	1A									



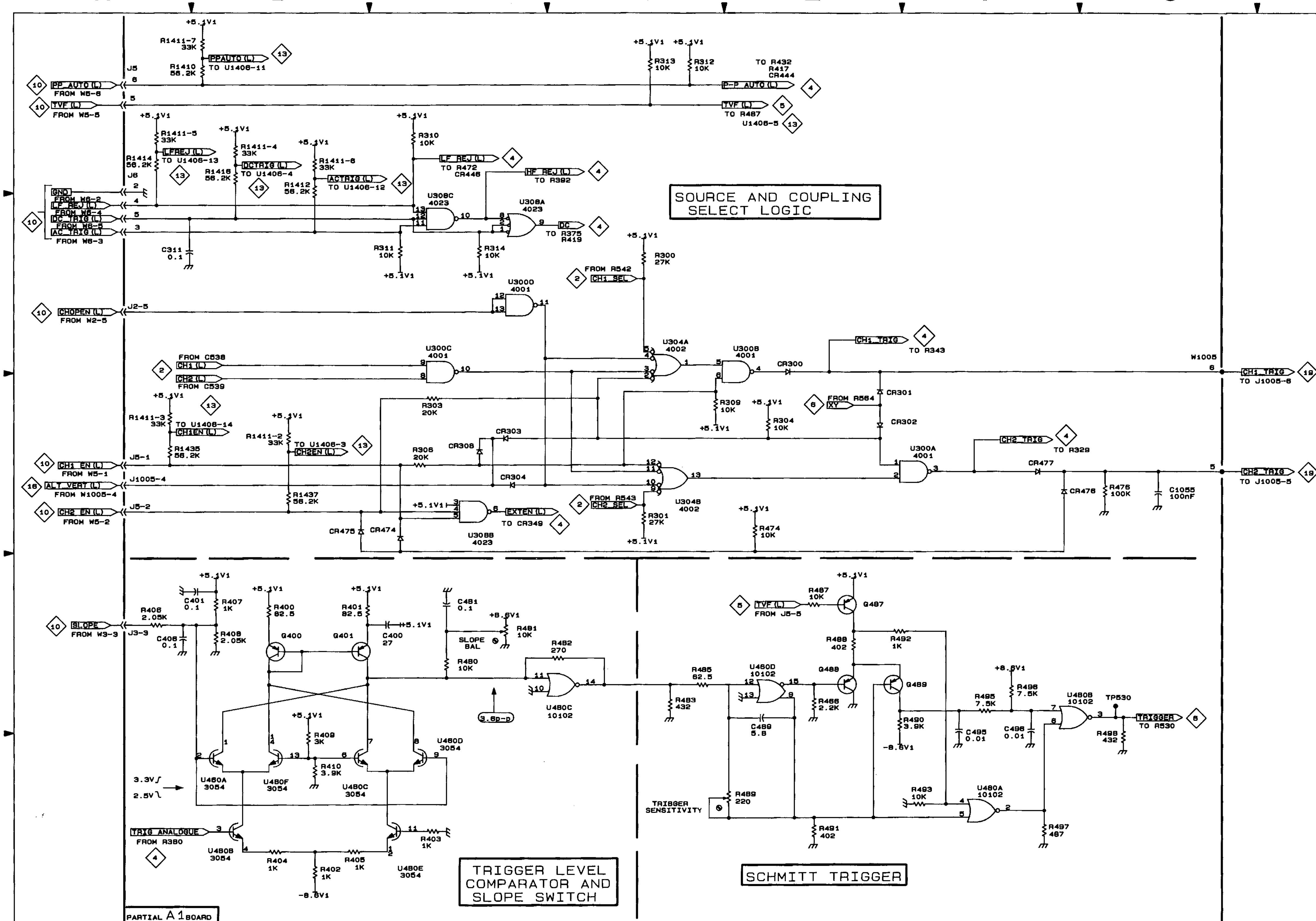
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY
EXTERNAL TRIGGER
TRIGGER AMPLFIER
POSITIVE PEAK RECTIFIER
NEGATIVE PEAK RECTIFIER
NORMAL DC & EXTERNAL AC
CH2 TRIGGER AMPLIFIER
CH1 TRIGGER AMPLIFER
PARTIAL A8 BOARD
PARTIAL A1 MAIN BOARD
NOTE W106, W107, W156, W157 ARE SHOWN AS Q106, Q107 ETC. ON SILK SCREEN
TRIGGER ANALOGUE
TO U4608-3
EXT TRIG
FROM W6-1
TRIG LEVEL1
FROM W3-4
TRIG LEVEL2
FROM W3-5
TRIG LEVEL3
FROM W3-6
P-P AUTO (L)
FROM J5-6
X AXIS
TO J90-4
X GAIN
TRIG LVL-
TO J1306-13
TRIG LVL+
TO J1306-14
CH2 TRIG
FROM U300-3
CH1 TRIG
FROM CR300
LF REJ (L)
FROM R310
HF REJ (L)
FROM U308-10
EXTEN (L)
FROM U308-6
DC
FROM U308-9
XY (L)
FROM W1008-2
-CH2
FROM R169
+CH2
FROM R168
-CH1
FROM R119
+CH1
FROM R118
EXT TRIG OFFSET
P-P OFFSET
2211
7234-04
TRIGGER

TRIGGER CONTROL DIAGRAM 5

Assembly A1

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C311	2A	8B	R300	2D	1E	R481	4C	5D	R1416	1B	6B
C400	4C	5D	R301	3D	2E	R482	4D	6D	R1435	3A	6B
C401	4A	5E	R303	3C	8B	R483	4D	6D	R1437	3B	7B
C408	4A	5D	R304	3E	8B	R485	4D	6D			
C481	4C	5E	R308	3C	8B	R486	4E	6D	TP530	4G	5E
C489	4E	5D	R309	3D	7B	R487	4E	6E			
C495	4F	5E	R310	1C	8B	R488	4E	5E	U300A	3E	8B
C496	4F	5E	R311	2C	8B	R489	5D	5D	U300B	2D	8B
			R312	1D	9C	R490	4E	5E	U300C	2C	8B
CR300	2E	7C	R313	1D	8B	R491	5E	5D	U300D	2C	8B
CR301	3E	6C	R314	2C	8B	R492	4E	5E	U304A	2D	7B
CR302	3E	7C	R400	4B	5C	R493	5F	6E	U304B	3D	7B
CR303	3C	7B	R401	4B	5D	R495	4F	5E	U308A	2C	8B
CR304	3C	7B	R402	5B	5C	R496	4F	5E	U308B	3C	8B
CR308	3C	7B	R403	5C	5C	R497	5F	5E	U308C	2C	8B
CR474	3C	7B	R404	5B	5C	R498	4G	6E	U460A	5B	6D
CR475	3B	7B	R405	5B	5C	R1410	1B	6B	U460B	5B	6D
CR476	3F	7B	R406	4A	5C	R1411-2	3B	7B	U460C	5B	6D
CR477	3F	7B	R407	4B	5C	R1411-3	3A	7B	U460D	5C	6D
			R408	4B	5C	R1411-4	1B	7B	U460E	5C	6D
Q400	4B	5D	R409	4B	6C	R1411-5	1A	7B	U460F	5B	6D
Q401	4B	5D	R410	5B	6C	R1411-6	1B	7B	U480A	5F	6E
Q487	4E	6E	R474	3E	7B	R1411-7	1B	7B	U480B	4F	6E
Q488	4E	5E	R476	3G	7B	R1412	1B	6B	U480C	4C	6E
Q489	4E	5E	R480	4C	5D	R1414	1A	6B	U480D	4E	6E

Partial A1 also shown on diagrams 2, 3, 4, 6, 9, 11, 12, 13 and 14.



2211

TRIGGER CONTROL 5

7234-05

WAVEFORMS FOR DIAGRAM 6

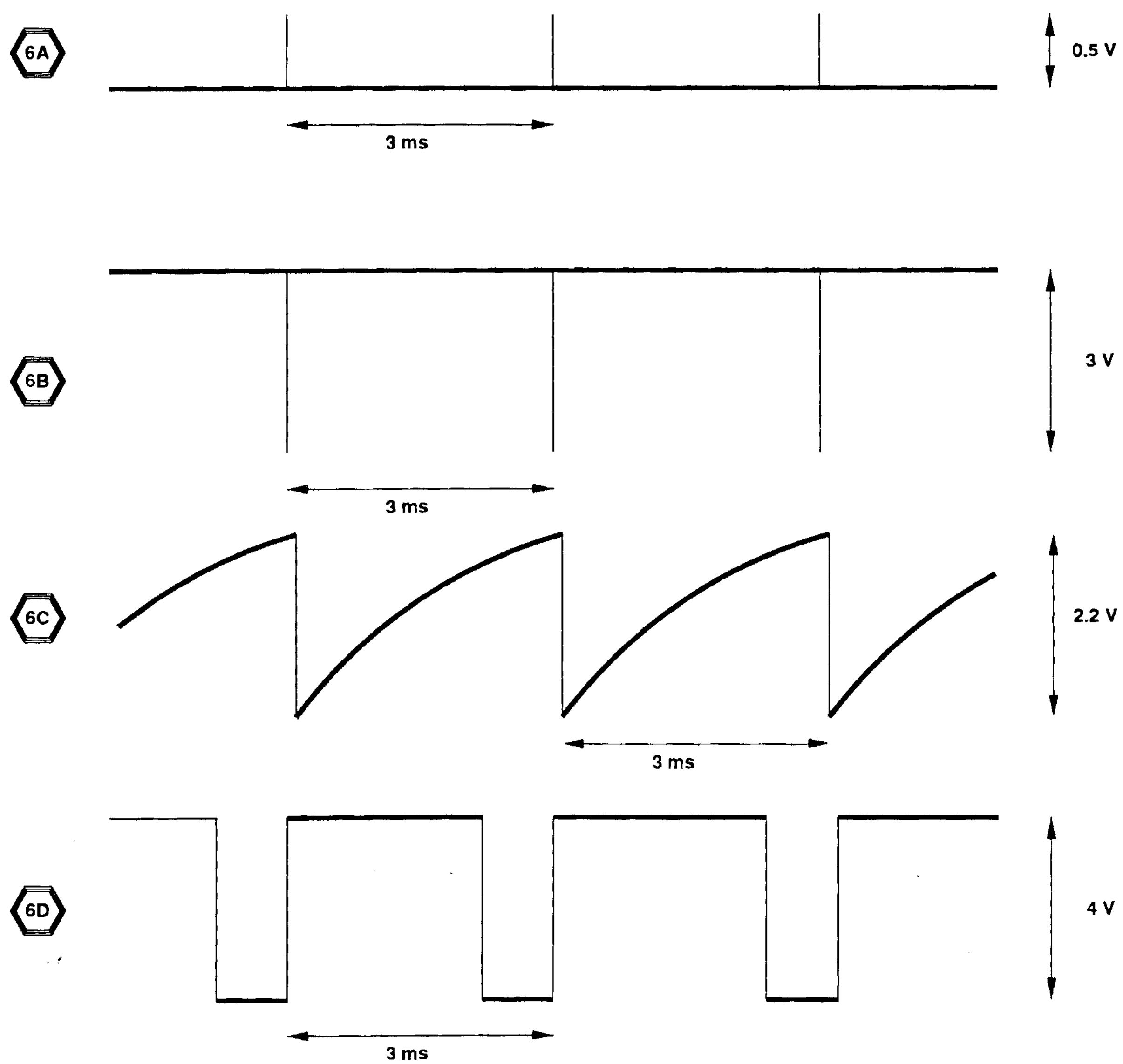
2211 CONTROL SETTINGS

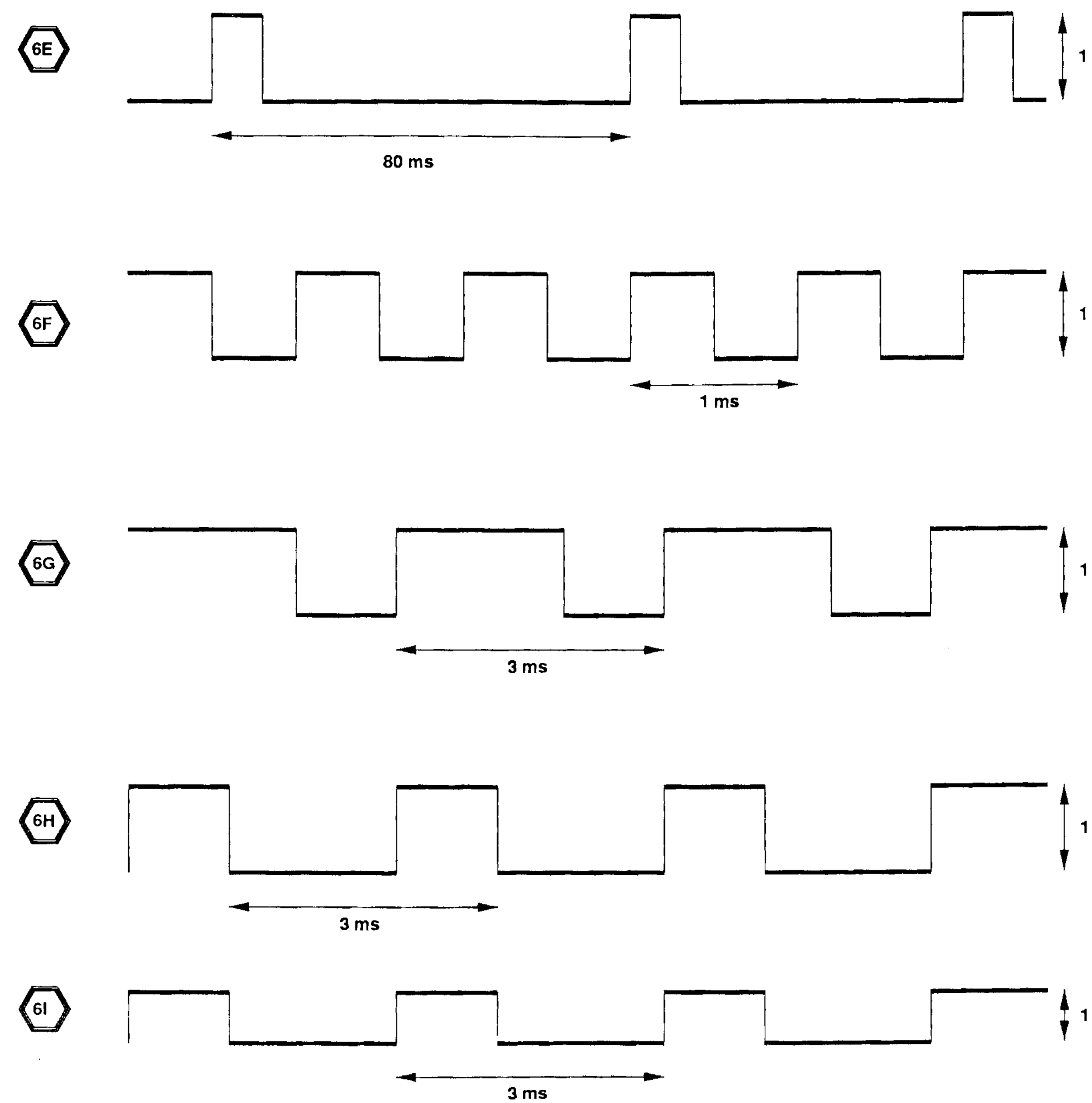
DC VOLTAGES

INTENSITY	MIDRANGE
HORIZONTAL MAG	X1
SEC/DIV	0.5 ms
TRIGGER MODE	P-P AUTO
STORE/NON-STORE	NON-STORE

AC WAVEFORMS

VERTICAL MODE	CH 1
AC-GND-DC (BOTH)	GND
HORIZONTAL MAG	X1
HORIZONTAL POSITION	MIDRANGE
SEC/DIV	0.5 ms
TRIGGER MODE	P-P AUTO
TRIGGER LEVEL	MIDRANGE
HOLDOFF	MIN (FULLY CCW)
STORE/NON-STORE	NON-STORE





7234-86

MORE

SWEEP LOGIC DIAGRAM 6

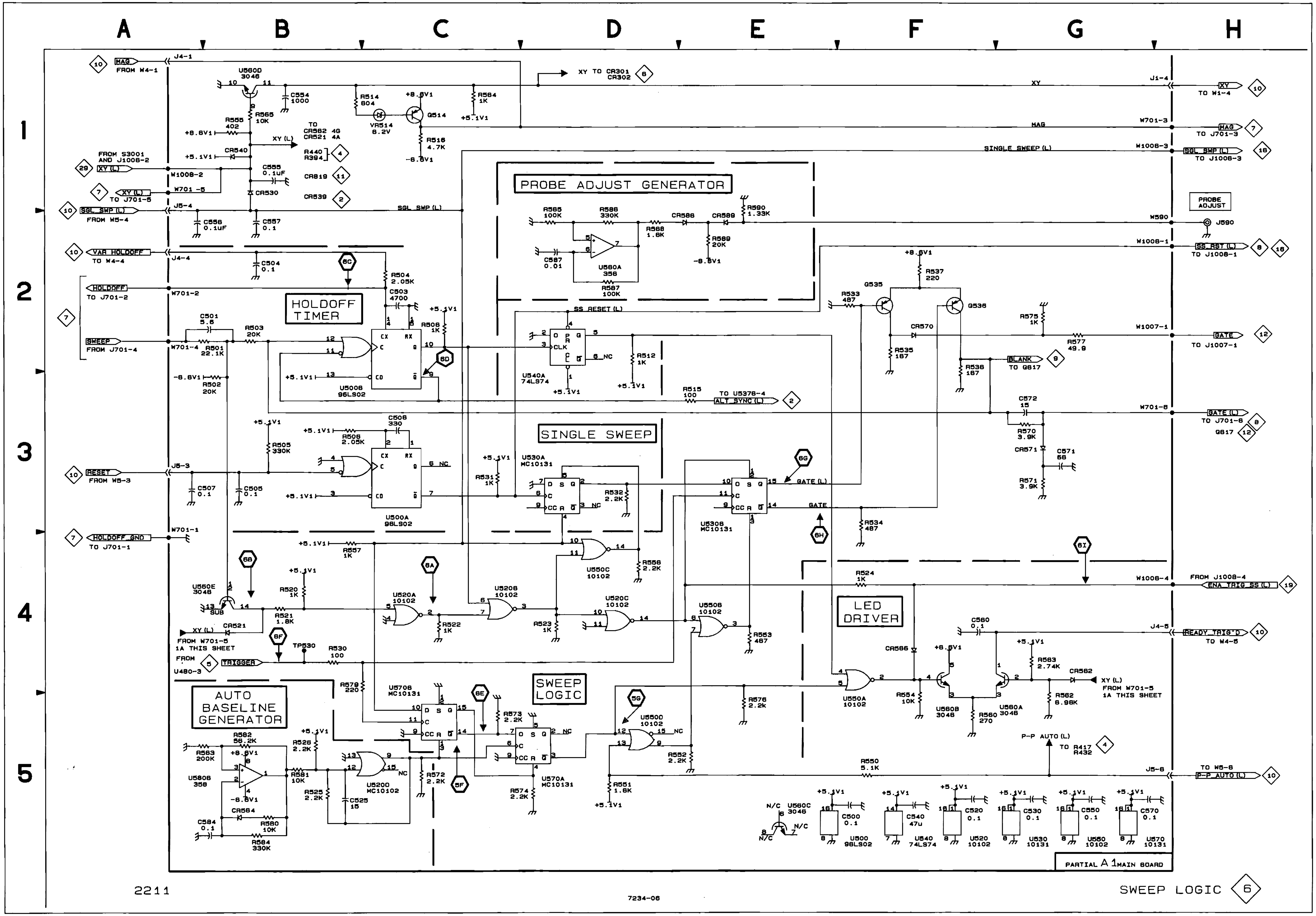
Assembly A1

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C500	5F	3F	CR589	2E	4D	R550	5F	3D	R589	2E	4D
C501	2B	4E				R551	5D	3D	R590	1E	4D
C503	2C	3E	Q514	1C	7A	R552	5E	2E			
C504	2B	5B	Q535	2F	3E	R553	4E	2E	U500A	3B	3F
C505	3B	2F	Q536	2F	3E	R554	5F	3E	U500B	2B	3F
C506	3C	3F				R555	1B	4E	U520A	4C	3D
C507	3A	8A	R501	2A	4E	R556	4D	2E	U520B	4C	3D
C520	5F	3D	R502	3B	4E	R557	4B	2E	U520C	4D	3D
C525	5B	3D	R503	2B	3E	R560	5F	3E	U520D	5B	3D
C530	5G	2E	R504	2C	5B	R562	5G	3E	U530A	3D	2E
C540	5F	2D	R505	3B	2E	R563	4G	3E	U530B	3E	2E
C550	5G	3D	R506	3B	3F	R564	1C	5C	U540A	2D	2E
C554	1B	3E	R508	2C	3E	R565	1B	4E	U550A	4F	2D
C555	1B	4E	R512	2D	1E	R570	3G	4E	U550B	4E	2D
C557	2B	6F	R514	1B	5A	R571	3G	4E	U550C	4D	2D
C558	2A	8A	R515	3E	3F	R572	5C	2D	U550D	5D	2D
C560	4F	4D	R516	1C	7A	R573	5C	3D	U560A	4F	3E
C570	5G	3D	R520	4B	3E	R574	5D	3D	U560B	4F	3E
C571	3G	4E	R521	4B	3E	R575	2G	3E	U560C	5E	3E
C572	3G	4E	R522	4C	3E	R576	5E	2D	U560D	1B	3E
C584	5B	4D	R523	4D	3E	R577	2G	3F	U560E	4B	3E
C587	2D	3D	R524	4F	3E	R579	4B	2E	U570A	5C	2D
			R525	5B	3D	R580	5B	4D	U570B	5C	2D
CR521	4B	4E	R526	5B	3D	R581	5B	3D	U580A	5B	4D
CR530	1B	4E	R530	4B	3E	R582	5B	4E	U580B	2D	4D
CR540	1B	4E	R531	3C	2E	R583	5A	4E			
CR562	4G	3E	R532	3D	2E	R584	5B	4D	VR514	1B	6A
CR566	4F	3E	R533	2F	2E	R585	2D	3D			
CR570	2F	3E	R534	3F	2E	R586	2D	4D	W590	1H	8A
CR571	3G	4E	R535	2F	2E	R587	2D	4D	W701	1A	4E
CR584	5B	4D	R536	2F	3D	R588	2D	4D	W1008	1A	6F
CR586	2E	4D	R537	2F	3E						

Partial A1 also shown on diagrams 2, 3, 4, 5, 9, 11, 12, 13 and 14.

OTHER PARTS

J590	2H	CHASSIS									



7234-06

SWEEP LOGIC 6

WAVEFORMS FOR DIAGRAM 7

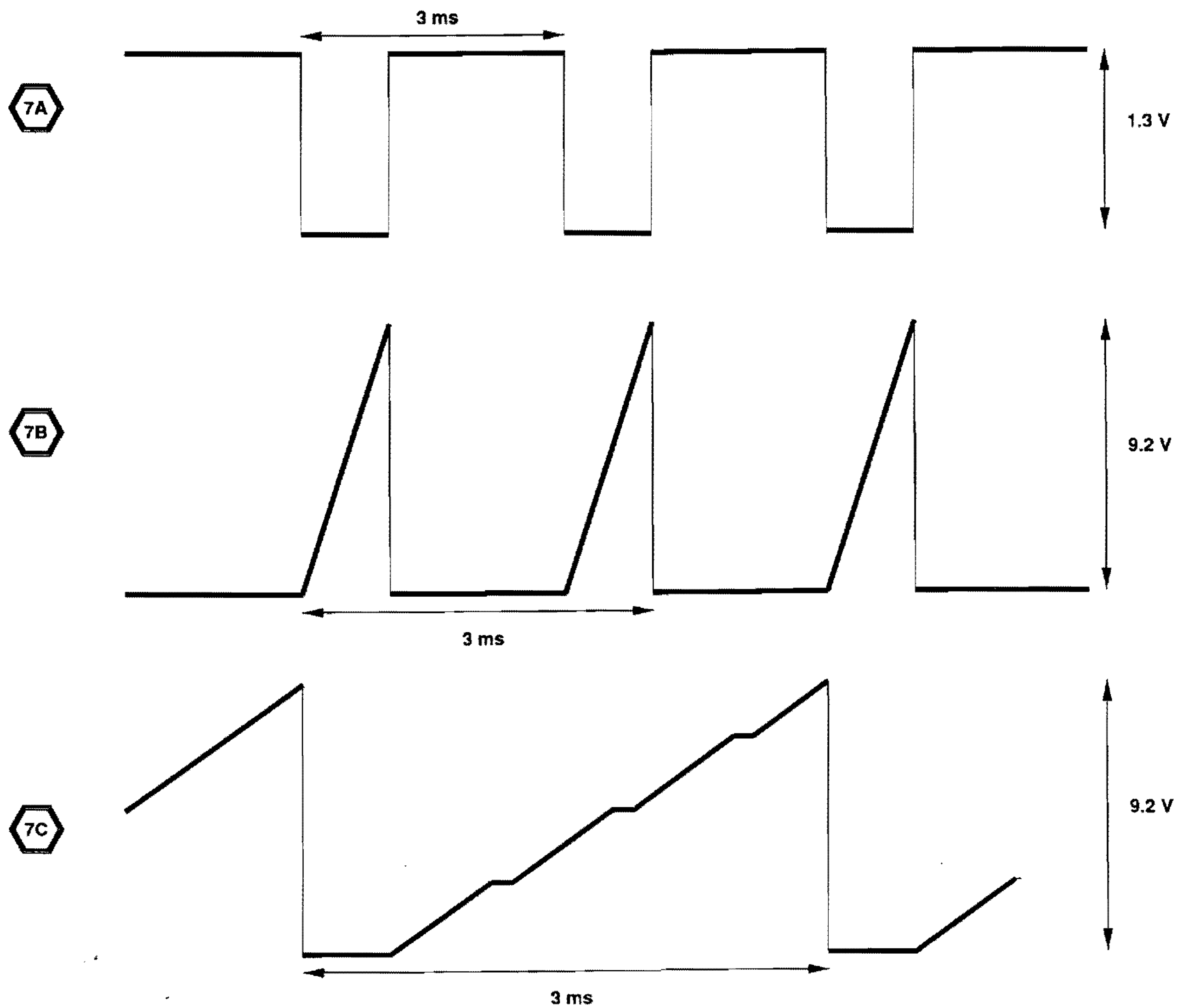
2211 CONTROL SETTINGS

DC VOLTAGES

INTENSITY	MIDRANGE
HORIZONTAL MAG	X1
SEC/DIV	0.5 ms
TRIGGER MODE	P-P AUTO
STORE/NON-STORE	NON-STORE

AC WAVEFORMS

VERTICAL MODE	CH 1
AC-GND-DC (BOTH)	GND
HORIZONTAL MAG	X1
HORIZONTAL POSITION	MIDRANGE
SEC/DIV	0.5 ms
TRIGGER MODE	P-P AUTO
TRIGGER LEVEL	MIDRANGE
HOLDOFF	MIN (FULLY CCW)
STORE/NON-STORE	NON-STORE



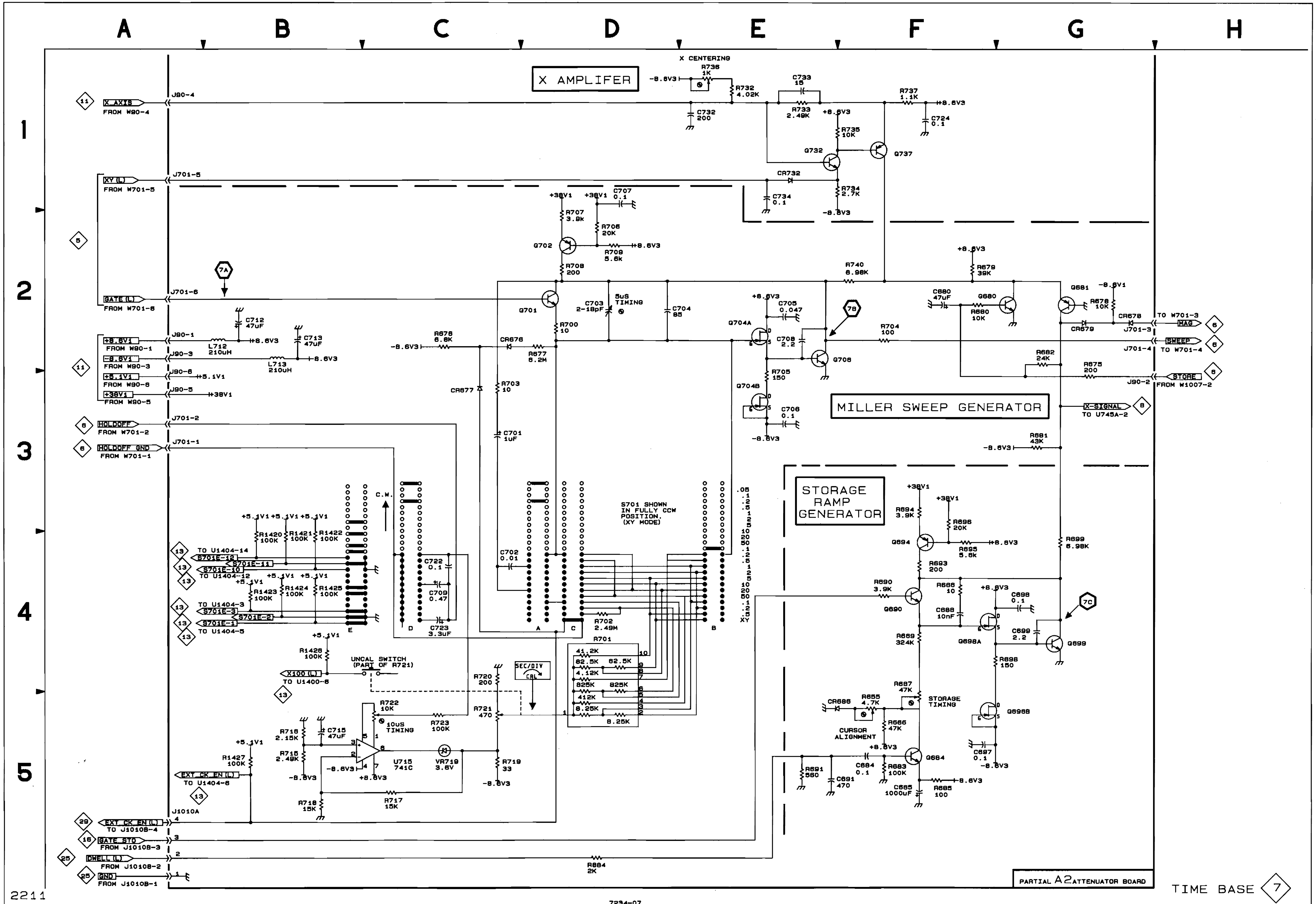
7234-87

TIME BASE DIAGRAM 7

Assembly A2

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C680	2F	3E	CR679	2G	4F	R678	2G	4G	R715	5B	6E
C684	5F	1D	CR686	5E	2D	R679	2F	4F	R716	5B	6E
C685	5F	1D	CR732	1E	4G	R680	2F	2E	R717	5C	6D
C688	4F	2E				R681	3G	3E	R718	5B	6E
C691	5E	2D	J701	1A	4F	R682	2G	3E	R719	5C	2E
C697	5F	2D	J1010	5A	1E	R683	5F	1D	R720	4C	3E
C698	4G	2E				R684	6D	1D	R721	5C	3E
C699	4G	2D	L712	2B	1C	R685	5F	1D	R722	5C	5D
C701	3C	6F	L713	2B	1C	R686	5F	1D	R723	5C	4E
C702	4C	6G				R687	5F	2C	R732	1E	1E
C703	2D	5F	Q680	2G	3E	R688	4F	1D	R733	1E	2E
C704	2D	5F	Q681	2G	4F	R689	4F	1E	R734	1E	4F
C705	2E	6G	Q684	5F	1D	R690	4F	1E	R735	1E	2E
C706	3E	6G	Q690	4F	2E	R691	5E	2D	R736	1E	2E
C707	1D	6G	Q694	4F	2D	R693	4F	2D	R737	1F	2E
C708	2E	6G	Q698A	4F	2E	R694	3F	3D	R740	2F	4F
C709	4C	4F	Q698B	5F	1D	R695	4F	2D	R1420	4B	4E
C712	2B	1C	Q699	4G	2E	R696	3F	3D	R1421	4B	4E
C713	2B	2C	Q701	2D	5F	R698	4F	2D	R1422	4B	4E
C715	5B	6F	Q702	2D	6F	R699	4G	3E	R1423	4B	4E
C722	4C	4F	Q704A	2E	6F	R700	2D	5F	R1424	4B	4E
C723	4C	5F	Q704B	3E	5F	R701	4D	5F	R1425	4B	4E
C724	1F	2E	Q706	2E	6F	R702	4D	5F	R1426	4B	3D
C732	1E	2E	Q732	1E	3E	R703	3C	5F	R1427	4B	4E
C733	1E	2E	Q737	1F	3E	R704	2F	6G			
C734	1E	4G				R705	3E	6F	S701	3D	6D
			R655	5F	2C	R706	2D	6G			
CR676	2C	5F	R675	3G	2D	R707	2D	6G	U715	5B	6E
CR677	3C	5F	R676	2C	5F	R708	2D	6G			
CR678	2G	4G	R677	2D	5F	R709	2D	6G	VR719	5C	6E

Partial A2 also shown on diagrams 1, 8 and 13.



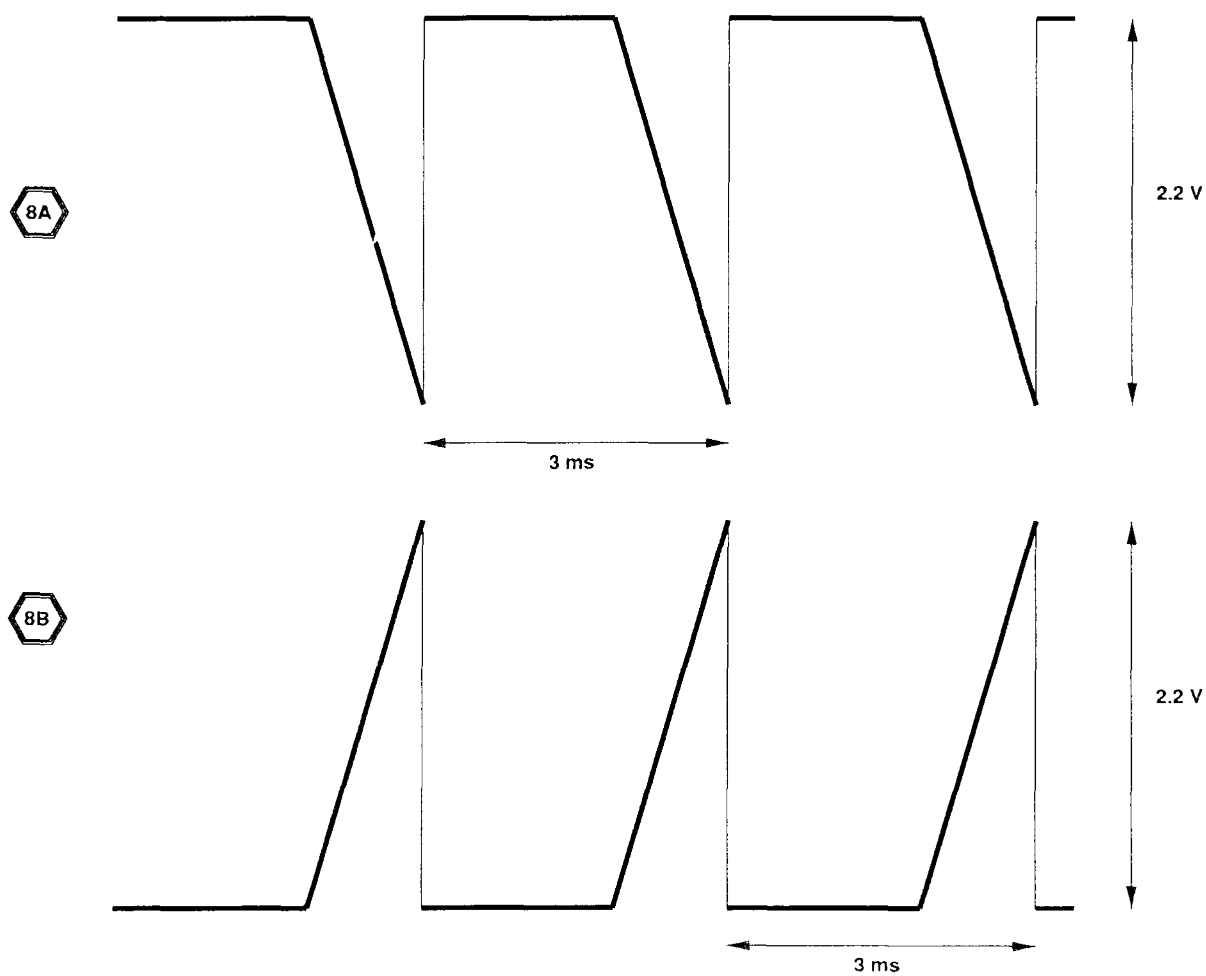
2211

TIME BASE 7

WAVEFORMS FOR DIAGRAM 8

2211 CONTROL SETTINGS

DC VOLTAGES		AC WAVEFORMS	
INTENSITY	MIDRANGE	VERTICAL MODE	CH 1
HORIZONTAL MAG	X1	AC-GND-DC (BOTH)	GND
SEC/DIV	0.5 ms	HORIZONTAL MAG	X1
TRIGGER MODE	P-P AUTO	HORIZONTAL POSITION	MIDRANGE
STORE/NON-STORE	NON-STORE	SEC/DIV	0.5 ms
		TRIGGER MODE	P-P AUTO
		TRIGGER LEVEL	MIDRANGE
		HOLDOFF	MIN (FULL CCW)
		STORE/NON-STORE	NON-STORE



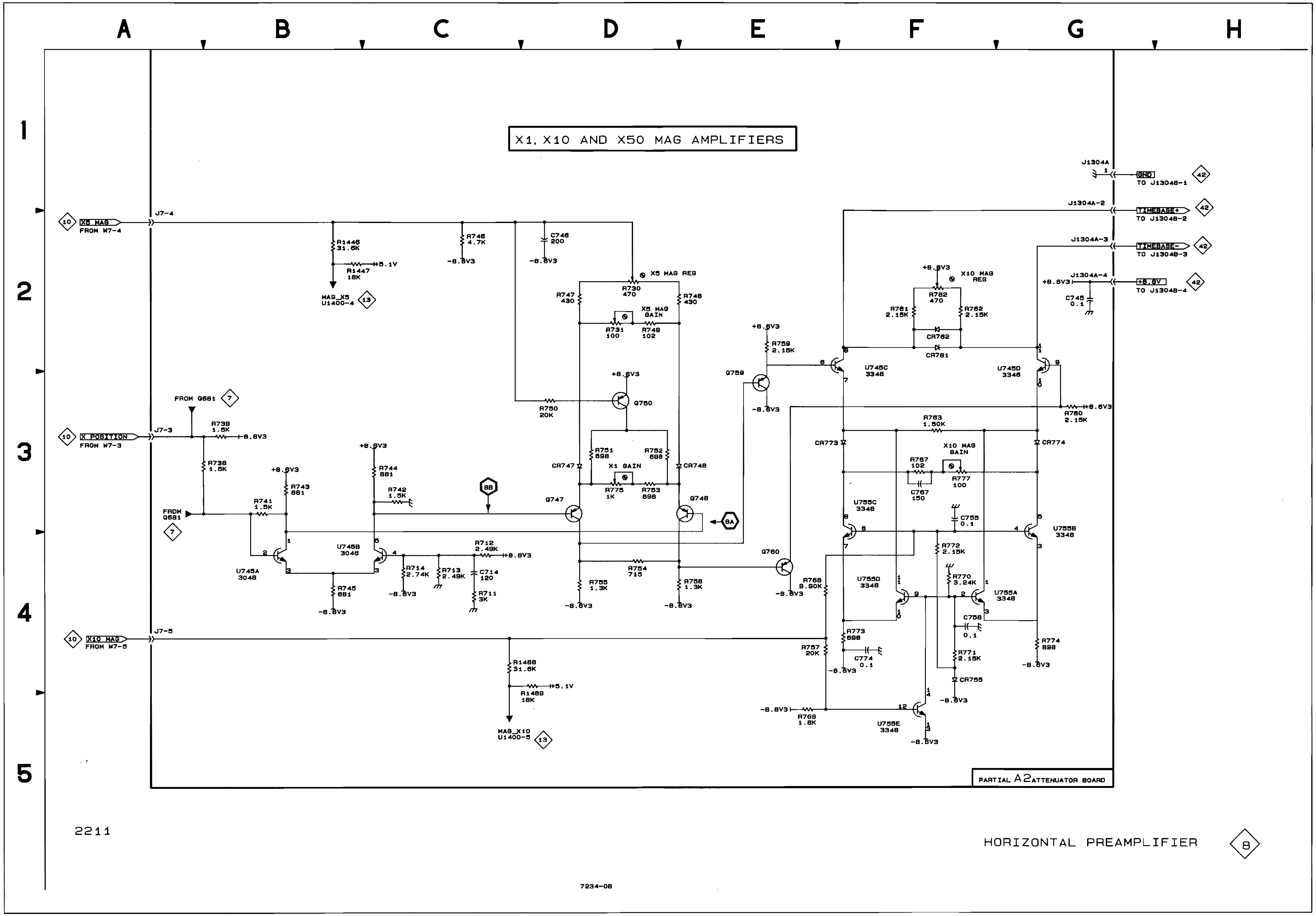
7234-88

HORIZONTAL PREAMPLIFIER DIAGRAM 8

Assembly A2

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C714	4C	3F	Q750	3D	4F	R749	2D	4F	R773	4F	2F
C745	2G	1G	Q759	3E	2G	R750	3D	4F	R774	4G	2F
C746	2D	4F	Q760	4E	2F	R751	3D	3G	R775	3D	2G
C755	3F	2F				R752	3D	3G	R777	3F	1E
C756	4F	2F	R711	4C	3G	R753	3D	3G	R782	2F	2G
C767	3F	1F	R712	4C	3F	R754	4D	2F	R1446	2B	3D
C774	4F	2F	R713	4C	3F	R755	4D	2F	R1447	2B	2D
			R714	4C	3F	R756	4D	2F	R1468	4C	2D
CR747	3D	3G	R730	2D	4G	R757	4E	1F	R1469	4D	2D
CR748	3D	3G	R731	2D	4G	R759	2E	3G			
CR755	4F	2F	R738	3A	3E	R760	3G	2F	U745A	4B	3E
CR761	2F	1G	R739	3B	3E	R761	2F	2G	U745B	4C	3E
CR762	2F	1G	R741	3B	3E	R762	2F	2G	U745C	2E	3E
CR773	3F	1F	R742	3C	3F	R763	3F	2F	U745D	2G	3E
CR774	3G	1F	R743	3B	3E	R767	3F	1F	U755A	4F	1F
			R744	3C	3F	R768	4E	2F	U755B	3G	1F
J1304A	1G	1F	R745	4B	3E	R769	5E	1F	U755C	3F	1F
			R746	2C	4F	R770	4F	2F	U755D	4F	1F
Q747	3D	3E	R747	2D	4G	R771	4F	2F	U755E	5F	1F
Q748	3D	3E	R748	2D	4G	R772	4F	2F			

Partial A2 also shown on diagrams 1, 7 and 13.



2211

HORIZONTAL PREAMPLIFIER 8

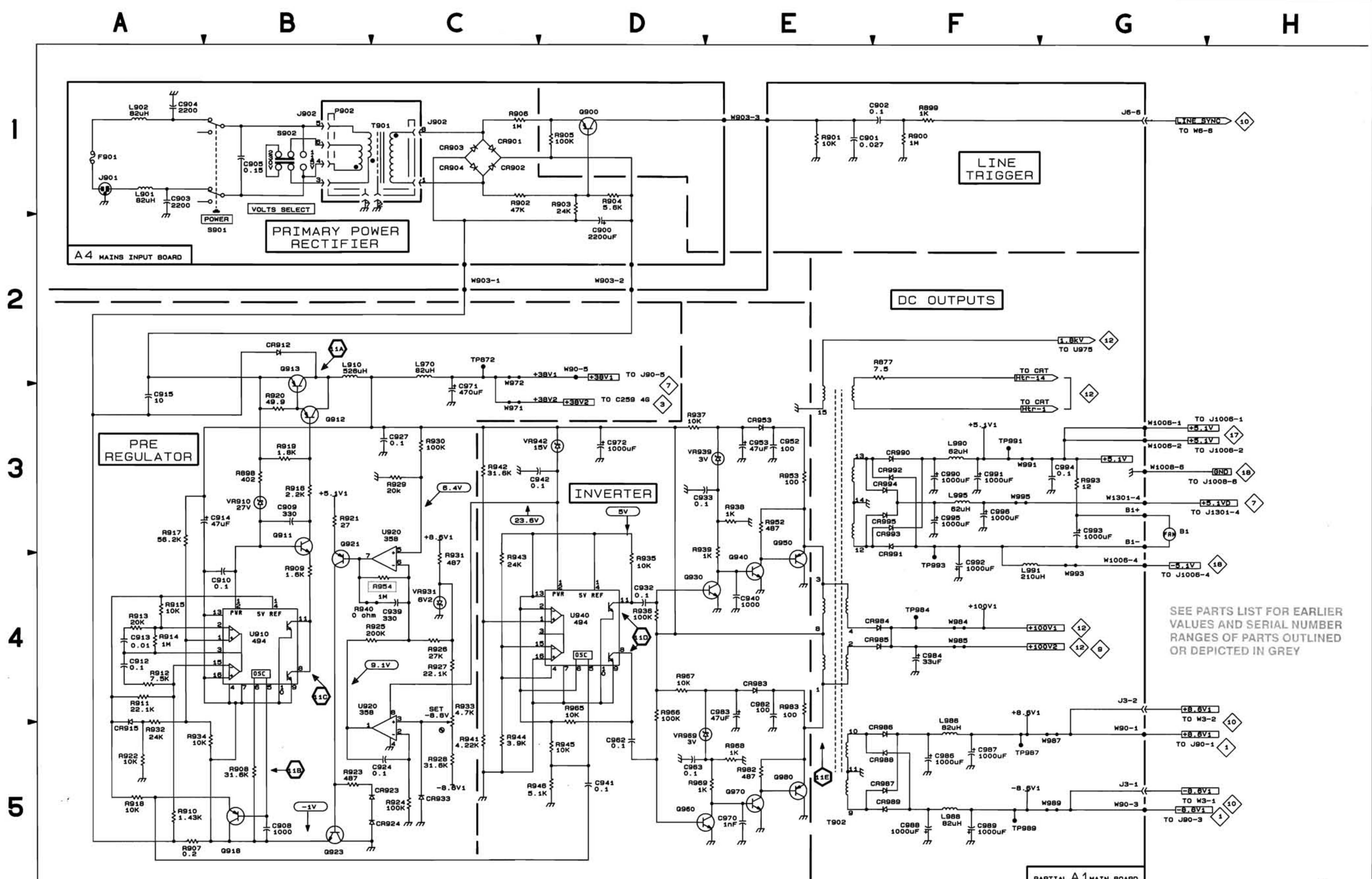
7234-08

HORIZONTAL OUTPUT AMPLIFIER DIAGRAM 9

Assembly A1

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C776	3D	3H	CR790	3C	3G	R776	3C	3G	R792	3D	4J
C780	3D	3H	CR791	3D	3H	R778	3F	3J	R794	3E	3J
C782	3E	3J				R779	3F	3J	R795	3E	3J
C784	2D	2J	Q770	2D	3H	R780	2D	3H	R796	4E	3H
C785	2E	2J	Q775	2E	3J	R781	3D	3G	R797	3F	3J
C789	2F	2J	Q776	4C	2H	R784	2D	3H	R798	3E	3J
C794	4E	4J	Q779	2E	3J	R785	2E	3J	R799	3F	3J
C795	3E	3J	Q780	3D	3H	R786	2E	3H	R828	4B	2H
C799	3F	3J	Q785	4E	3J	R787	2F	3J			
			Q789	3E	3J	R788	3E	2J	VR776	3C	3H
CR776	4C	2H				R789	3F	3J	VR792	3E	3H
CR780	3C	3G	R262	3C	2H	R790	3D	3H			
CR781	3D	3H	R764	3C	3H	R791	3D	3H	W1301	2B	4F

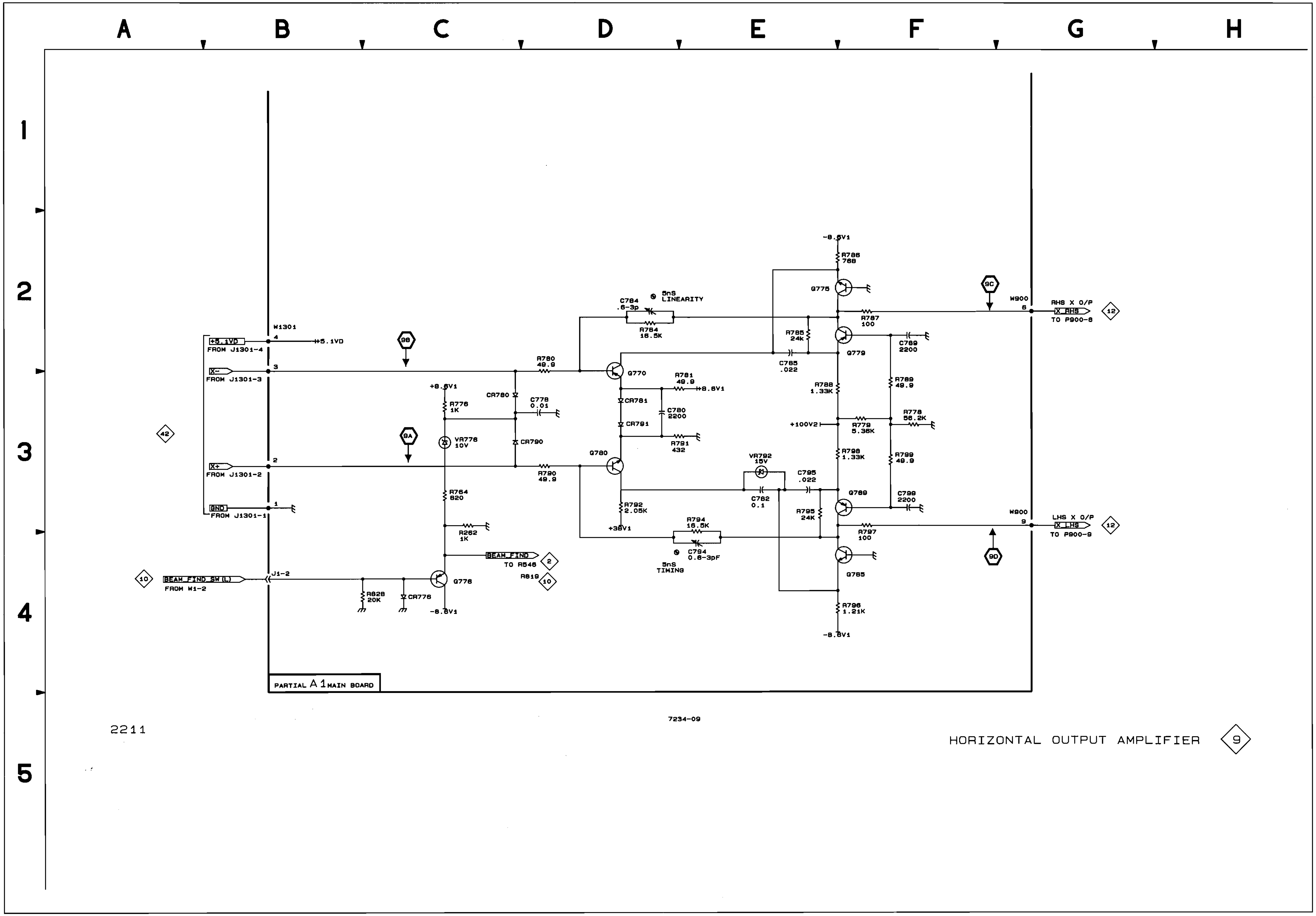
Partial A1 also shown on diagrams 2, 3, 4, 5, 6, 11, 12, 13 and 14.



2211

POWER SUPPLY 11

7234-11



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HORIZONTAL OUTPUT AMPLIFIER 9

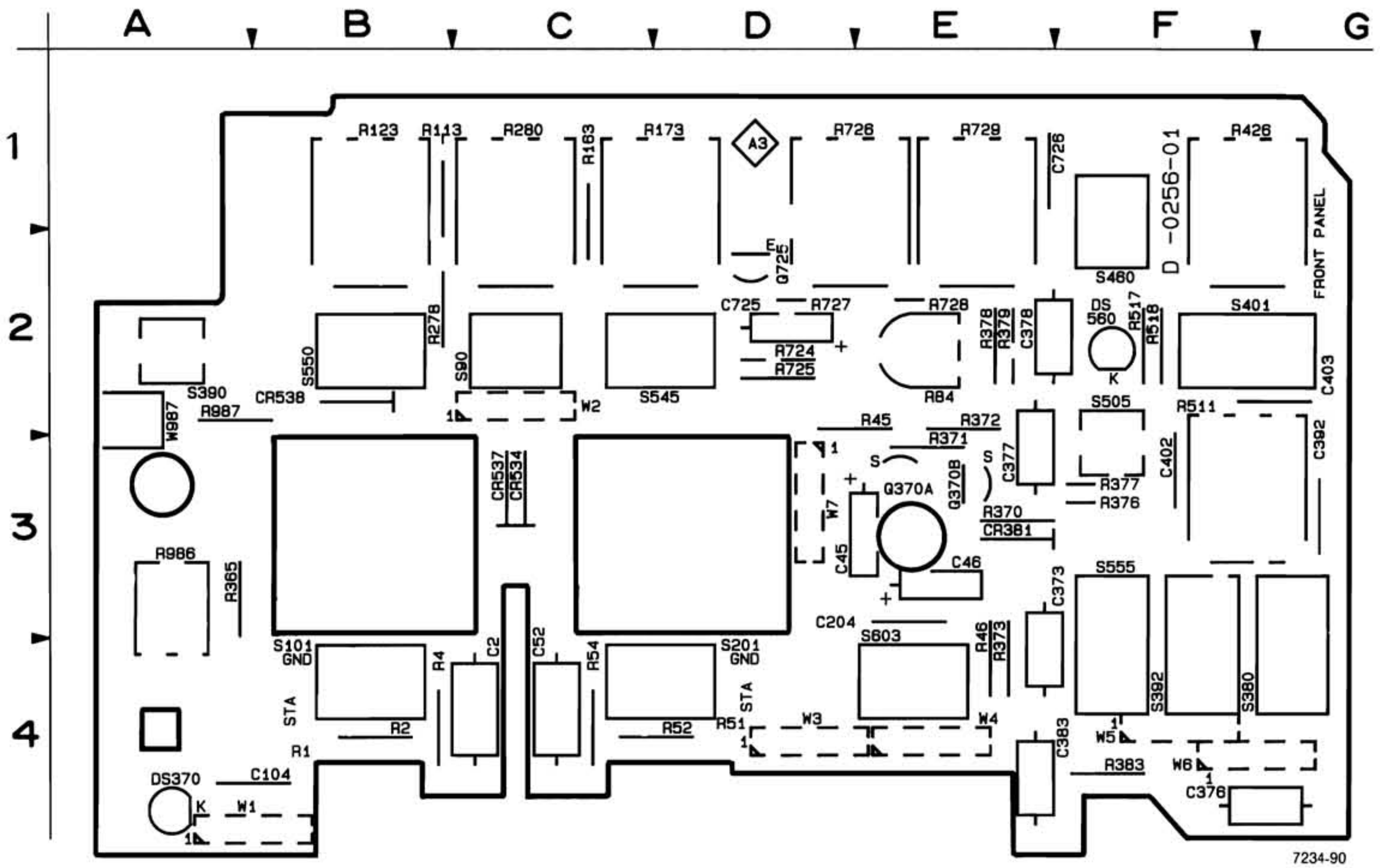
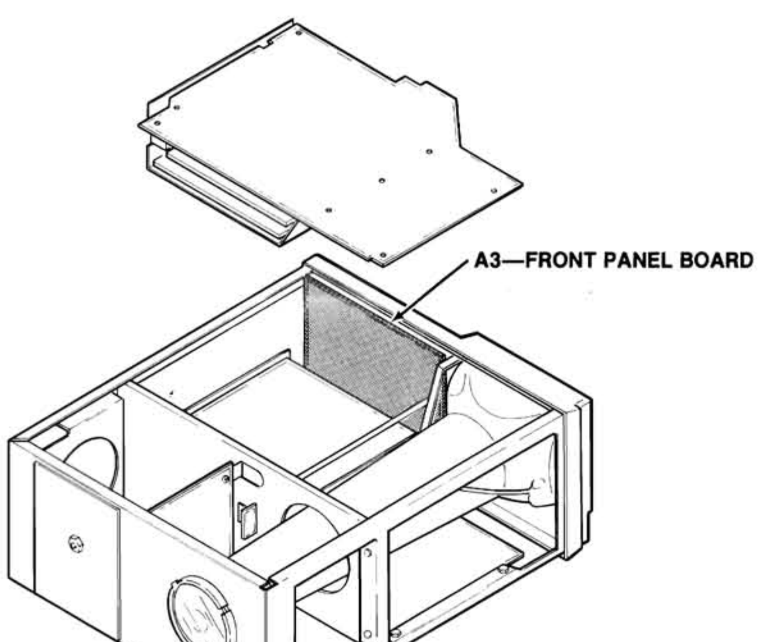


Figure 9-9. A3—Front Panel board.



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—FRONT PANEL BOARD

CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
C2	10	C726	10	R2	10	R370	10	R725	10	S460	10
C45	10			R4	10	R371	10	R726	10	S505	10
C46	10	CR381	10	R45	10	R372	10	R727	10	S545	10
C52	10	CR534	10	R46	10	R373	10	R728	10	S550	10
C104	10	CR537	10	R51	10	R376	10	R729	10	S555	10
C204	10	CR538	10	R52	10	R377	10	R986	10	S603	10
C373	10			R54	10	R378	10	R987	10		
C376	10	DS370	10	R84	10	R379	10			W1	10
C377	10	DS560	10	R113	10	R382	10	S90	10	W2	10
C378	10			R123	10	R383	10	S101	10	W3	10
C383	10	Q370A	10	R163	10	R426	10	S201	10	W4	10
C392	10	Q370B	10	R173	10	R511	10	S380	10	W5	10
C402	10	Q725	10	R278	10	R517	10	S390	10	W6	10
C403	10			R280	10	R518	10	S392	10	W7	10
C725	10	R1	10	R365	10	R724	10	S401	10	W987	10

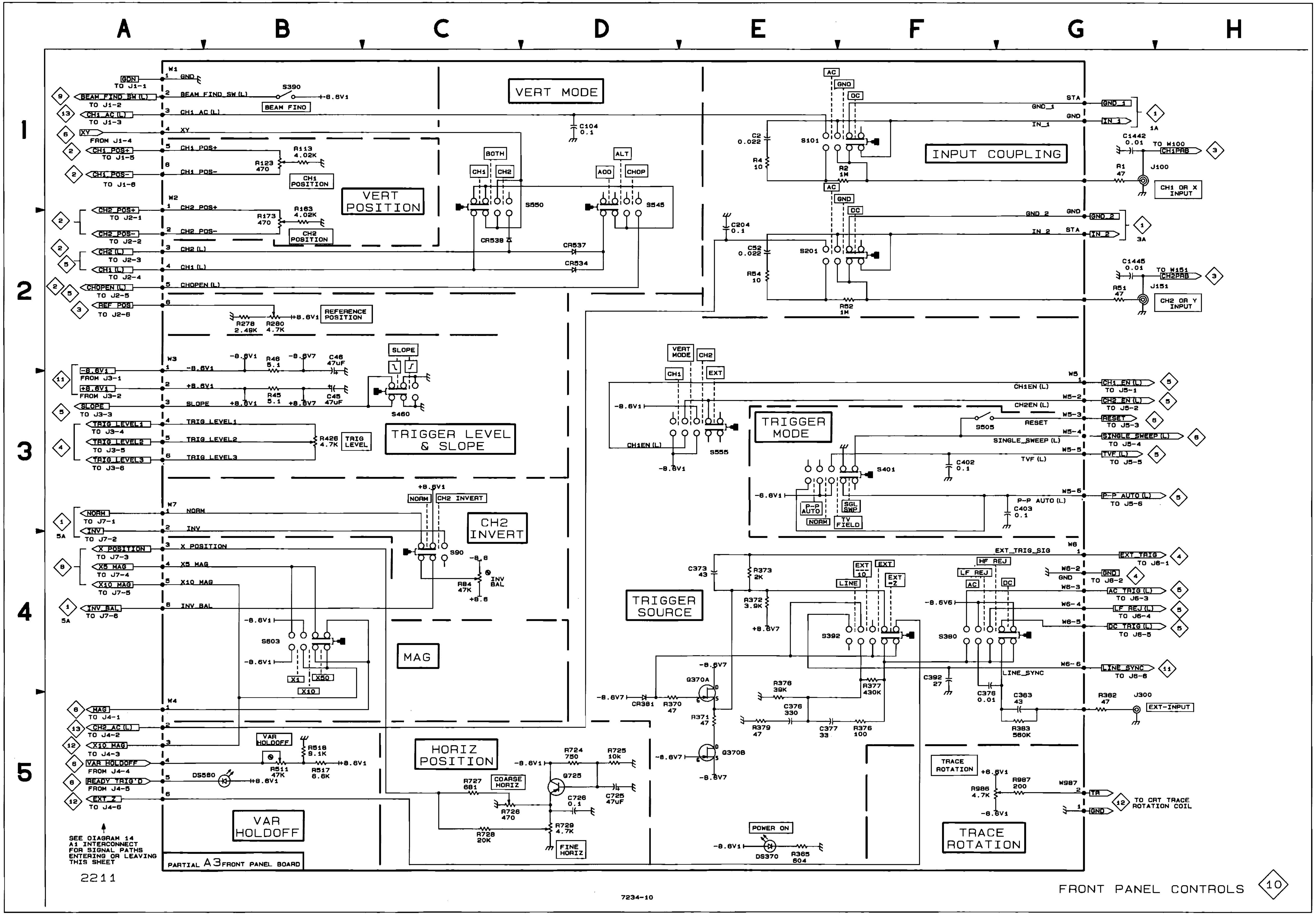
FRONT PANEL CONTROLS DIAGRAM 10

Assembly A3

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C2	1E	4C	DS560	5B	2F	R371	5E	3E	S90	4C	2C
C45	3B	3D				R372	4E	2E	S101	1E	4B
C46	2B	3E	Q370A	4E	3E	R373	4E	4E	S201	2E	4D
C52	2E	4C	Q370B	5E	3E	R376	5F	3F	S380	4F	4F
C104	1D	4B	Q725	5D	2D	R377	4F	3F	S390	1B	2A
C204	2E	3D				R378	5E	2E	S392	4F	4F
C373	4E	3F	R1	1G	4B	R379	5E	2E	S401	3E	2F
C376	4F	4F	R2	1F	4B	R382	5G	4E	S460	3C	2F
C377	5E	3E	R4	1E	4B	R383	5G	4F	S505	3F	2F
C378	5E	2E	R45	3B	2E	R426	3B	1F	S545	1D	2D
C383	5G	4F	R46	2B	4E	R511	5B	2F	S550	1C	2B
C392	4F	3G	R51	2G	4D	R517	5B	2F	S555	3D	3F
C402	3F	3F	R52	2F	4D	R518	5B	2F	S603	4B	3E
C403	3G	2G	R54	2E	4C	R724	5D	2D			
C725	5D	2D	R84	4C	2E	R725	5D	2D	W1	1A	4A
C726	5D	1F	R113	1B	1B	R726	5C	1D	W2	1A	2C
			R123	1B	1B	R727	5C	2D	W3	2A	4D
CR381	5D	3E	R163	2B	1C	R728	5C	2E	W4	5A	4E
CR534	2D	3C	R173	2B	1D	R729	5D	1E	W5	3G	4F
CR537	2D	3C	R278	2B	2B	R986	5F	3A	W6	4C	4F
CR538	2C	2B	R280	2B	1C	R987	5G	2A	W7	3A	3D
			R365	5E	3A				W987	5G	2A
DS370	5E	4A	R370	5D	3E						

OTHER PARTS

J100	1G	CHASSIS	J151	5G	CHASSIS	J300	2G	CHASSIS			



FRONT PANEL CONTROLS 10

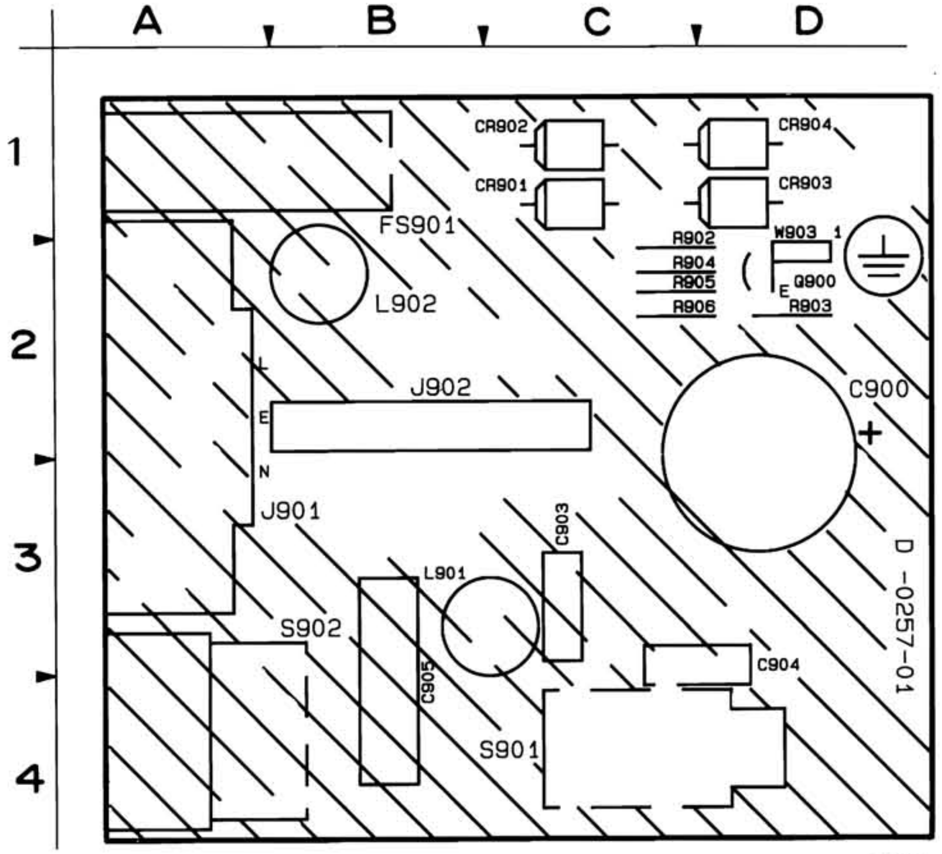
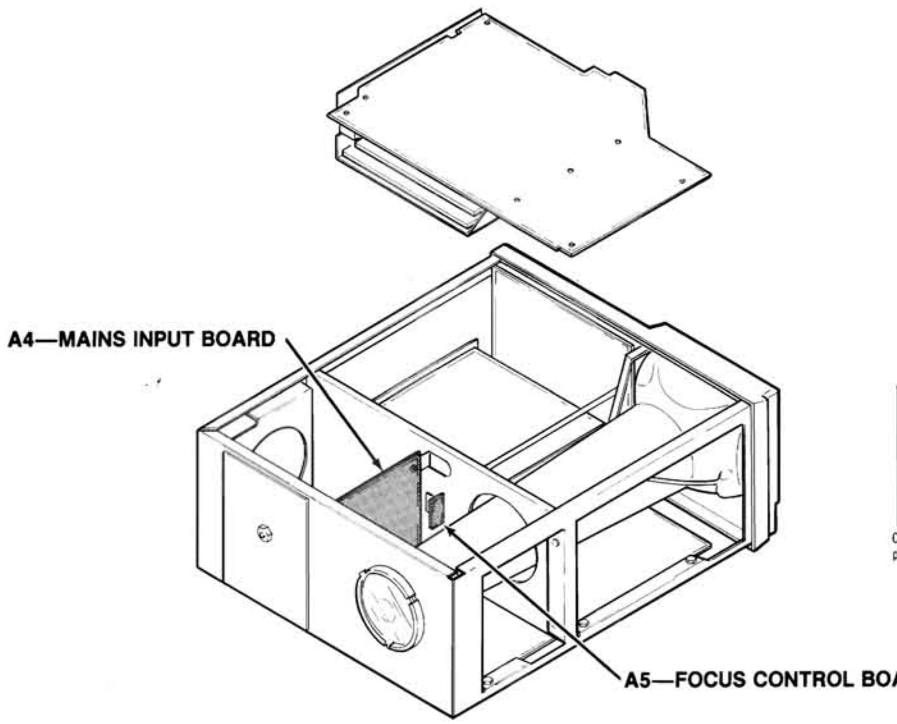
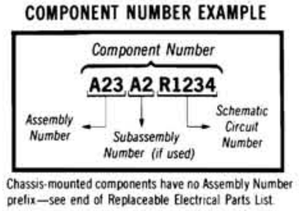


Figure 9-10. A4—Mains Input board.



Static Sensitive Devices
See Maintenance Section



A4—MAINS INPUT BOARD

CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
C900	11	CR901	11	F901	11	L901	11	R902	11	S901	11
C903	11	CR902	11			L902	11	R903	11	S902	11
C904	11	CR903	11	J901	11			R904	11		
C905	11	CR904	11	J902	11	Q900	11	R905	11	W903	11
								R906	11		

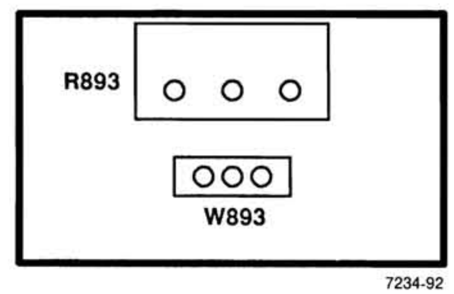


Figure 9-11. A5—Focus Control board.

A5—FOCUS CONTROL BOARD

CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
R893	12										

A4—MAINS INPUT BOARD

CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
C900	11	CR901	11	F901	11	L901	11	R902	11	S901	11
C903	11	CR902	11			L902	11	R903	11	S902	11
C904	11	CR903	11	J901	11			R904	11		
C905	11	CR904	11	J902	11	Q900	11	R905	11	W903	11
								R906	11		

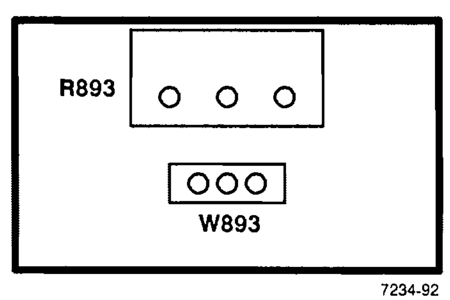


Figure 9-11. A5—Focus Control board.

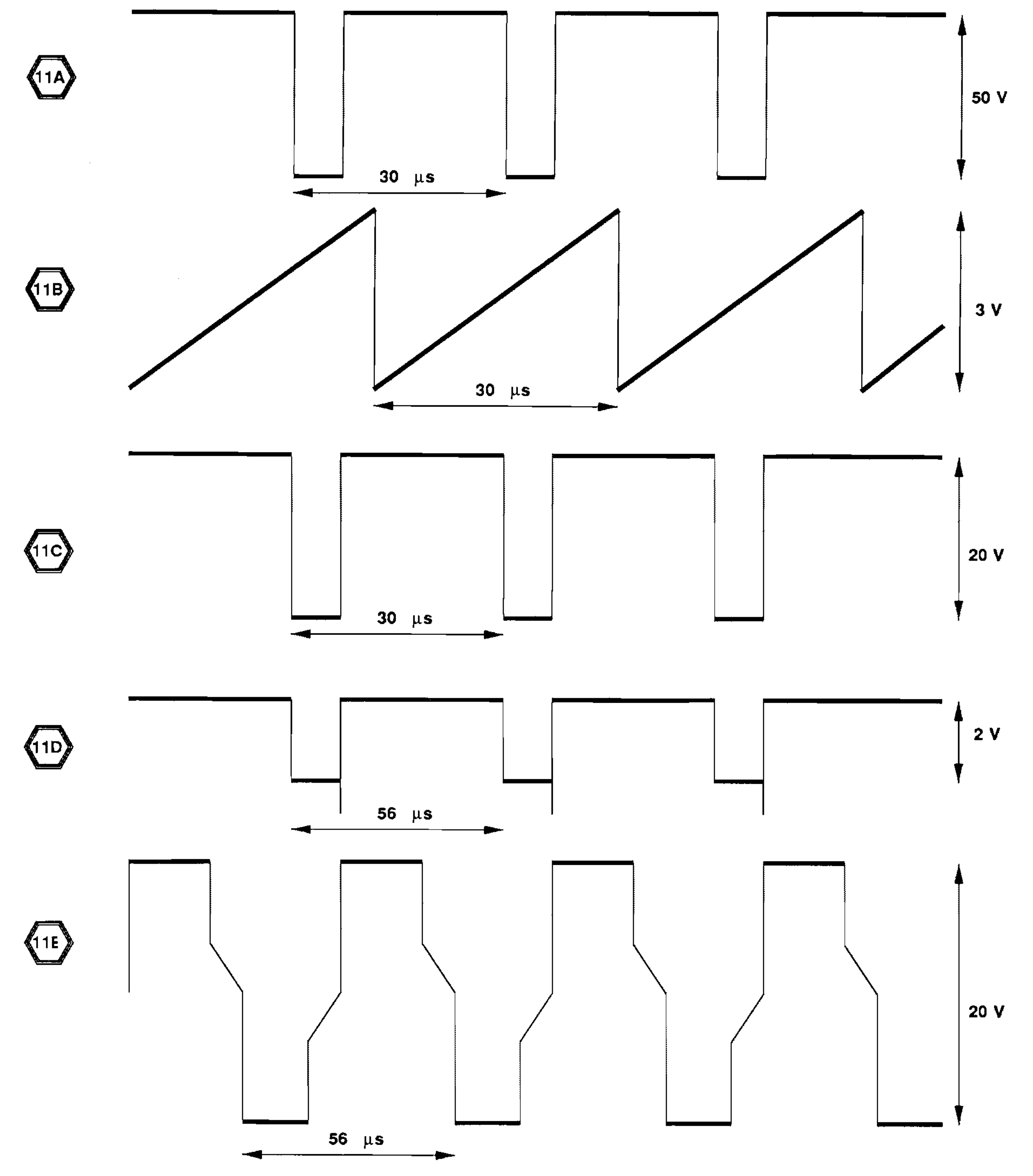
A5—FOCUS CONTROL BOARD

CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
R893	12										

WAVEFORMS FOR DIAGRAM 11

2211 CONTROL SETTINGS

DC VOLTAGES		AC WAVEFORMS	
INTENSITY	MIDRANGE	VERTICAL MODE	CH 1
VERTICAL MODE	CH 1	AC-GND-DC (BOTH)	GND
AC-GND-DC (BOTH)	GND	TRIGGER MODE	P-P AUTO
TRIGGER MODE	P-P AUTO	TRIGGER SOURCE	CH 1
TRIGGER SOURCE	CH 1	STORE/NON-STORE	NON-STORE
STORE/NON-STORE	NON-STORE		



POWER SUPPLY DIAGRAM 11

Assembly A1

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C901	1E	6H	CR933	5C	7J	R907	5A	6J	R954	4C	8J
C902	1F	6H	CR953	3E	7H	R908	5B	7J	R965	4D	7J
C908	5B	7J	CR983	4E	7J	R909	4B	6J	R966	4D	7J
C909	3B	6J	CR984	4F	6H	R910	5A	6J	R967	4D	7J
C910	4B	6J	CR985	4F	6G	R911	4A	7J	R968	5E	7J
C912	4A	7J	CR986	5F	6G	R912	4A	7J	R969	5E	7J
C913	4A	7J	CR987	5F	6G	R913	4A	7J	R982	5E	8H
C914	3A	5J	CR988	5F	7G	R914	4A	7J	R983	4E	8J
C915	3A	8J	CR989	5F	7G	R915	4A	7J	R993	3G	9F
C924	5C	8J	CR990	3F	8G	R916	3B	8J			
C927	3C	7J	CR991	3F	8G	R917	3A	6J	T902	5E	7G
C932	4D	7J	CR992	3F	8G	R918	5A	6J			
C933	3D	7H	CR993	3F	8F	R919	3B	9J	TP872	2C	6F
C939	4C	8J	CR994	3F	8F	R920	3B	9J	TP984	4F	6F
C940	4E	8H	CR995	3F	8F	R921	3B	9J	TP987	5F	7F
C941	5D	6J				R922	5A	7J	TP989	5F	7F
C942	3C	6H	L910	2B	5J	R923	5B	9J	TP991	3F	8F
C952	3E	8H	L970	2C	6H	R924	5C	8J	TP993	4F	9F
C953	3E	7H	L986	5F	6F	R925	4B	7J			
C962	5D	7J	L988	5F	7F	R926	4C	8J	U910	4B	6J
C963	5D	7J	L990	3F	7F	R927	4C	9H	U920A	4C	3D
C970	5E	8J	L991	4F	9F	R928	5C	9H	U920B	3C	8J
C971	3C	6H	L995	3F	8E	R929	3C	7J	U940	4D	7J
C972	3D	7H				R930	3C	7J			
C982	4E	8J	Q911	3B	6J	R931	4C	9H	VR910	3B	6J
C983	4E	7J	Q912	3B	8J	R932	4A	7J	VR931	4C	8J
C984	4F	6G	Q913	2B	8J	R933	4C	8H	VR939	3E	7H
C986	5F	6G	Q918	5B	6J	R934	5B	6J	VR942	3D	6H
C987	5F	7F	Q921	3B	8J	R935	4D	7J	VR969	5D	7J
C988	5F	6G	Q923	5B	8J	R936	4D	7H			
C989	5F	7F	Q930	4D	8J	R937	3D	7H	W90	5G	6E
C990	3F	7G	Q940	4E	8J	R938	3E	7J	W903	1E	6H
C991	3F	8F	Q950	3E	8G	R939	3E	7H	W971	3C	3J
C992	4F	8F	Q960	5D	8J	R940	4C	8J	W972	2C	6F
C993	3G	9F	Q970	5E	8J	R941	5C	6J	W984	4F	6F
C994	3G	9F	Q980	5E	8G	R942	3C	6J	W985	4F	3J
C995	3F	8F				R943	4C	6H	W987	5G	7F
C996	3F	7F	R877	2F	5H	R944	5C	6H	W989	5G	8F
			R898	3B	6J	R945	5D	6J	W991	3F	8F
CR912	2B	8J	R899	1F	6H	R946	5D	6J	W993	4G	9F
CR915	4A	7J	R900	1F	6H	R952	3E	8G	W995	3F	7F
CR923	5B	9J	R901	1E	6H	R953	3E	8H	W1006	3G	8F
CR924	5B	9J									

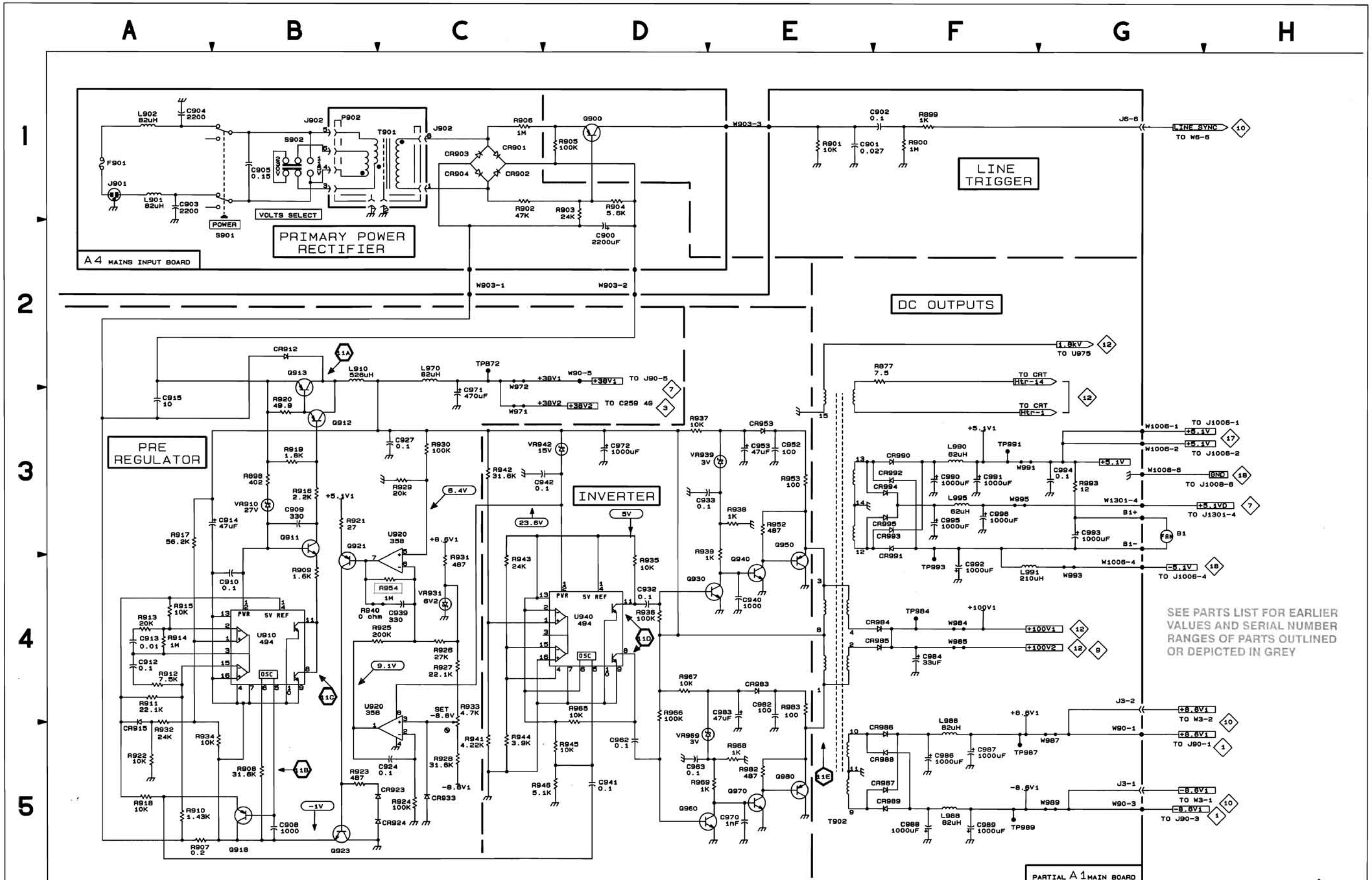
Partial A1 also shown on diagrams 2, 3, 4, 5, 6, 9, 12, 13 and 14.

Assembly A4

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C900	2D	2D	CR904	1C	1D	L902	1A	2B	R905	1D	2C
C903	1A	3C							R906	1C	2C
C904	1A	3D	F901	1A	1B	Q900	1D	2D			
C905	1B	4B							S901	1B	4C
			J901	1A	3B	R902	1C	2C	S902	1B	3B
CR901	1C	1C	J902	1B	2B	R903	1D	2D			
CR902	1C	1C				R904	1D	2C	W903	2C	1D
CR903	1C	1D	L901	1A	3B						

OTHER 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
B1	3G	CHASSIS	T901	1B	CHASSIS						



2211

POWER SUPPLY 11

7234-11

WAVEFORMS FOR DIAGRAM 12

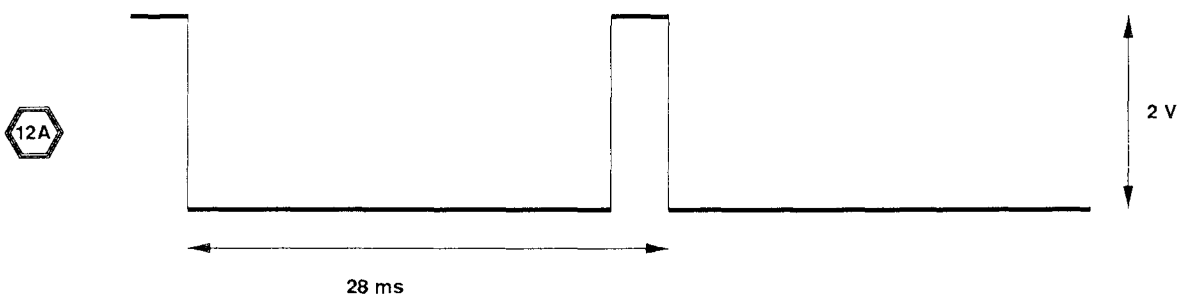
2211 CONTROL SETTINGS

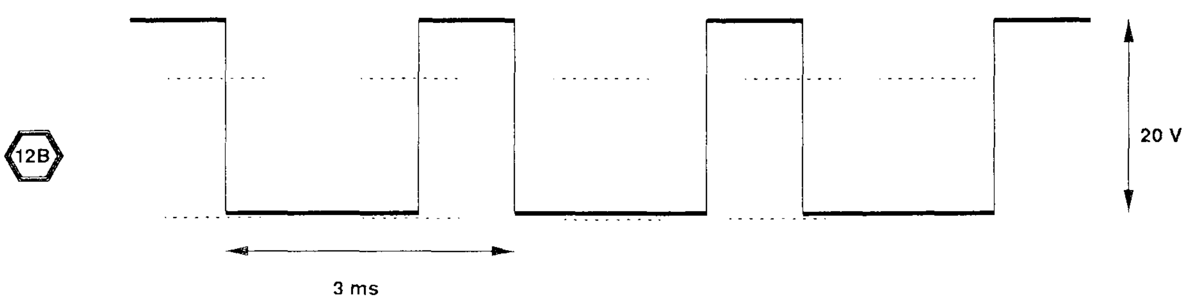
DC VOLTAGES

INTENSITY	MIDRANGE
VERTICAL MODE	CH 1
AC-GND-DC (BOTH)	GND
TRIGGER MODE	P-P AUTO
TRIGGER SOURCE	CH 1
STORE/NON-STORE	NON-STORE

AC WAVEFORMS

VERTICAL MODE	CH 1
AC-GND-DC (BOTH)	GND
TRIGGER MODE	P-P AUTO
TRIGGER SOURCE	CH 1
STORE/NON-STORE	NON-STORE





7234-94

HIGH VOLTAGE & CRT DIAGRAM 12

Assembly A1

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C817	2B	3F
C824	3C	4F
C828	3C	3G
C832	2C	3G
C834	3C	3G
C835	3C	3G
C845	2D	3G
C846	3C	3G
C847	2D	2G
C849	2D	3G
C851	3D	6G
C853	4E	6H
C854	2E	4H
C855	2D	4G
C871	2G	5F
C875	4G	5F
C893	3E	4H
C975	3E	4J
C976	3E	4J
C979	3E	4J
C1059	4B	BKBD
CR805	4B	5F
CR806	3B	5F
CR807	3B	4F
CR814	2B	4F
CR815	2B	4F
CR816	2B	4E
CR817	3B	4F
CR818	3C	4F
CR819	2B	4E
CR820	2B	4E
CR821	2B	4E
CR822	2B	4F

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
CR823	3B	4F
CR827	2C	3G
CR828	3C	3G
CR840	3C	3G
CR845	2C	3G
CR851	3D	6G
CR853	3D	4G
CR854	2E	4H
CR855	2D	4H
CR1408	4C	5A
DS856	2D	4H
DS858	2D	4J
DS870	2E	4J
J800	3B	2F
Q801	5B	2F
Q802	4A	1F
Q803	4C	2F
Q804	3B	4G
Q805	5A	2F
Q817	2B	3E
Q825	1B	4E
Q835	3C	3G
Q840	3D	3G
Q845	2D	3G
R800	3A	1F
R801	4B	1E
R803	4A	2F
R804	3B	4G
R805	3B	4G

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R806	3B	4F
R807	4A	1F
R808	4B	1F
R809	4C	2F
R810	5B	1F
R811	3A	BKBD
R812	4A	2F
R813	4B	1F
R814	5A	2F
R815	5A	1F
R816	5B	1E
R817	4C	2F
R818	4C	4F
R819	3C	3F
R820	2B	4E
R821	3B	4E
R823	1B	4D
R824	1B	8A
R825	1B	4F
R832	2C	3G
R834	3C	3G
R835	3C	3G
R836	3C	3G
R840	3C	3G
R841	3C	3G
R842	3D	4G
R844	2C	3G
R845	2C	3H
R846	2C	3G
R849	2D	3G
R850	3D	6G
R851	3D	6F
R852	3D	6F

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R853	3E	6H
R854	2E	4G
R858	2E	4J
R860	2D	4J
R870	2G	5F
R871	2G	5F
R872	3G	2J
R873	3G	2J
R874	3G	5F
R875	3G	5F
R886	1D	4G
R888	1D	3G
R889	1D	3G
R890	1E	3H
R891	1E	3H
R892	1E	3H
R894	1E	4H
R976	3E	5J
R978	3E	5J
R1407	5D	6B
R1408	4C	5B
R1409	4B	5B
R1411	4D	7B
TP842	2D	4G
U975	2E	6G
U1407A	4G	5B
U1407B	5C	5B
W893	1H	4H
W1008	2A	6F
W1301	5A	4F

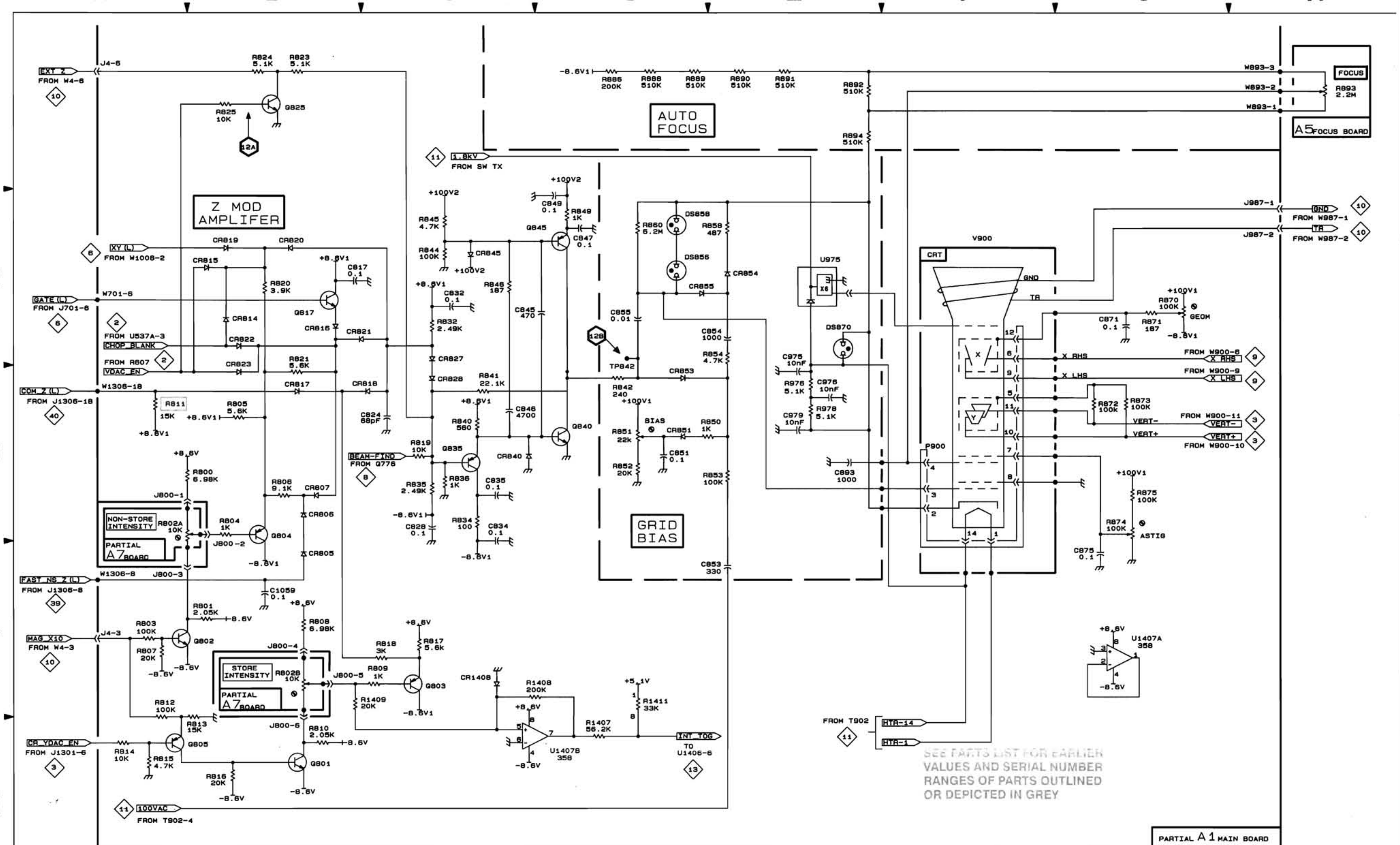
Partial A1 also shown on diagrams 2, 3, 4, 5, 6, 9, 11, 13 and 14.

Assembly A5

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R893	1H	1A

Assembly A7

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R802A	3A	1A
R802B	4B	1A



HIGH VOLTAGE & CRT 12

2211

7234-12

SHIFT REGISTERS DIAGRAM 13

Assembly A1

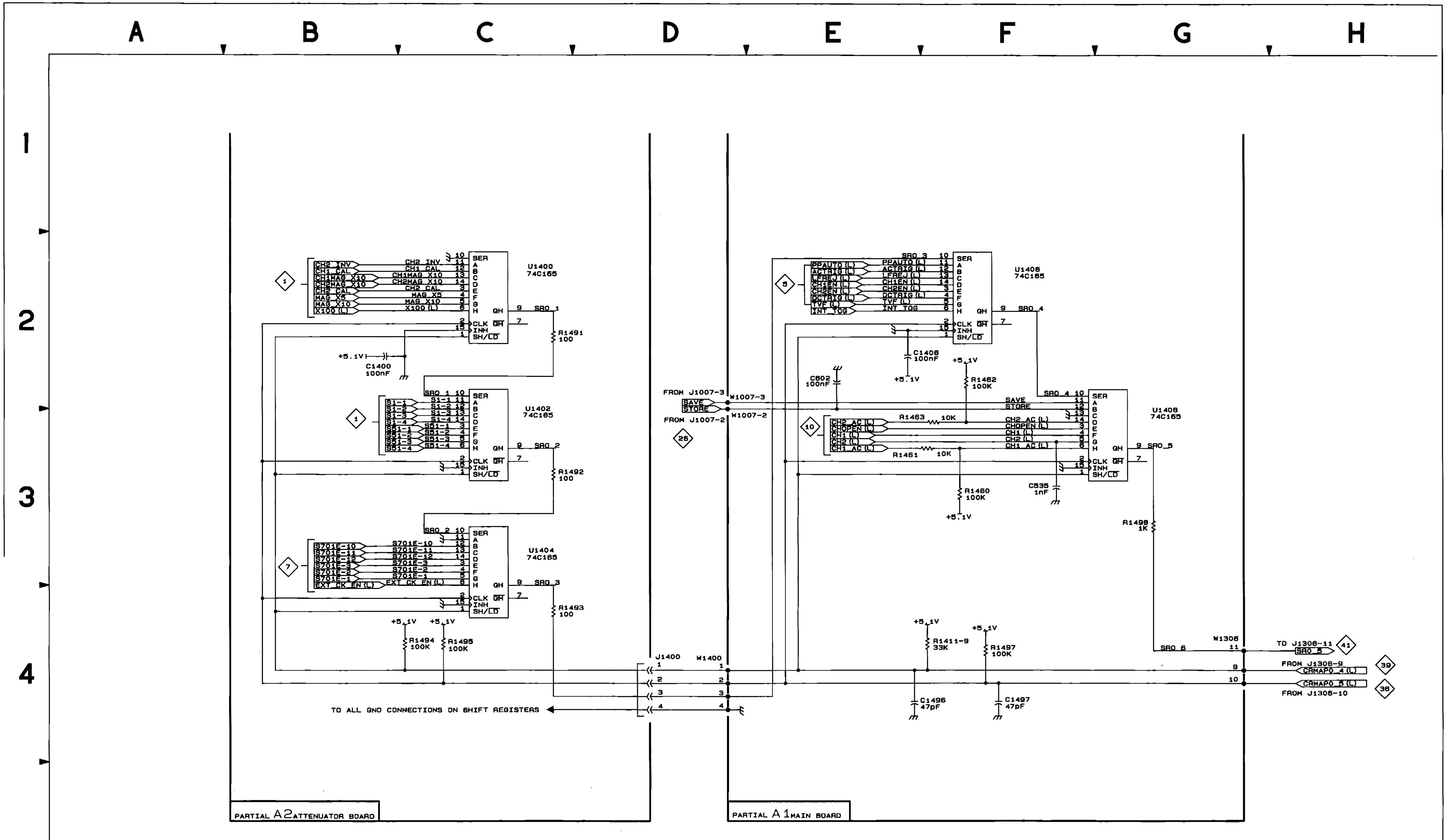
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C535	3F	5E	R1411-9	4F	7B	R1497	4F	6B	U1408	2F	6B
C602	2E	5E	R1460	3E	6B	R1498	3F	5B			
C1406	2E	6B	R1461	3E	6B				W1007	2D	4F
C1496	4E	5E	R1462	3E	6B	U1406	2F	7B	W1400	4D	4D
C1497	4F	5E	R1463	3E	6B						

Partial A1 also shown on diagrams 2, 3, 4, 5, 6, 9, 11, 12 and 14.

Assembly A2

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1400	2B	3C	R1491	2C	2C	R1494	4C	2B	U1400	2C	3C
			R1492	3C	1B	R1495	4C	3D	U1402	2C	2B
J1400	4D	1A	R1493	4C	1B				U1404	3C	4D

Partial A2 also shown on diagrams 1, 7 and 8.



2211

SHIFT REGISTERS 13

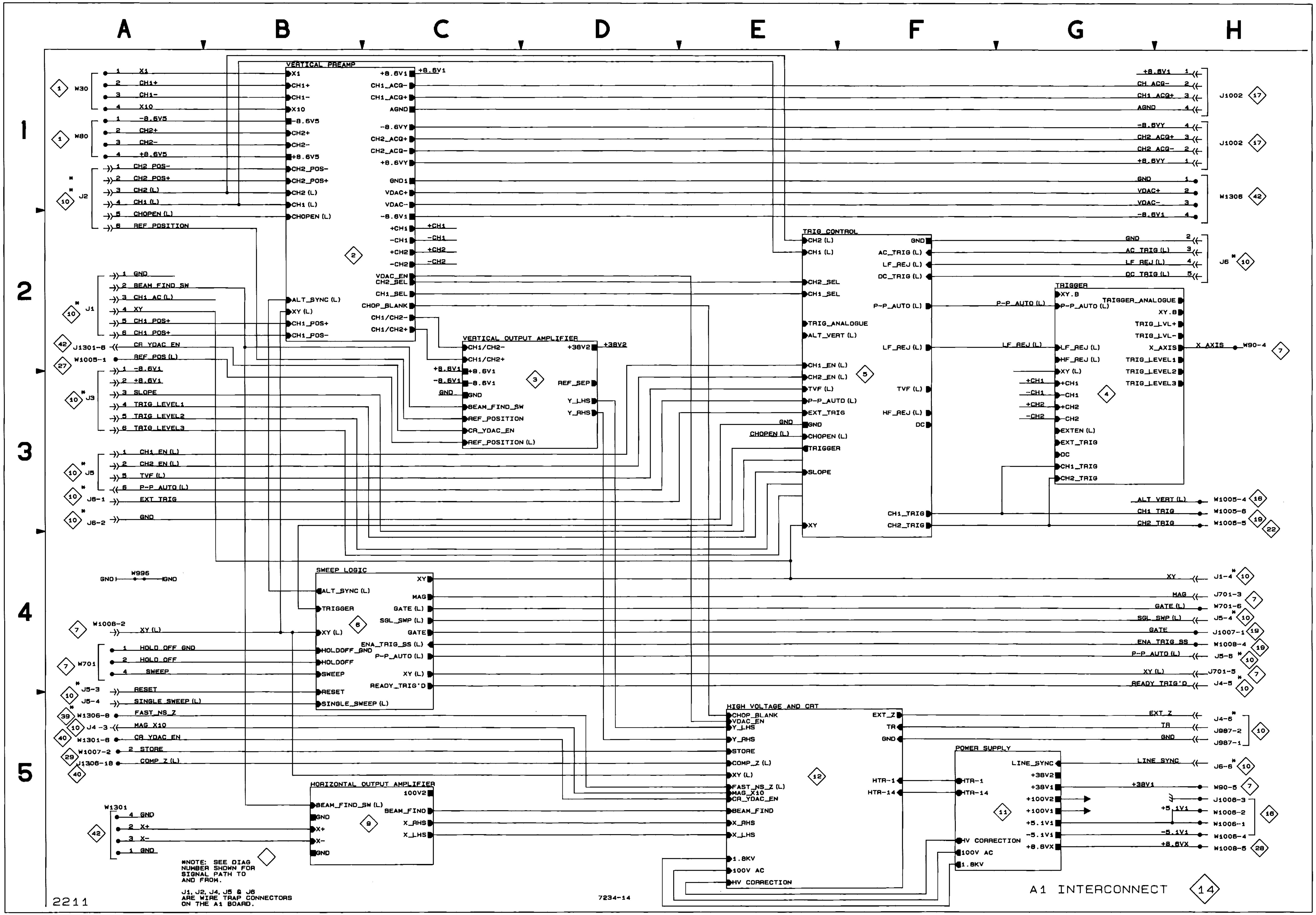
7234-13

A1 INTERCONNECT DIAGRAM 14

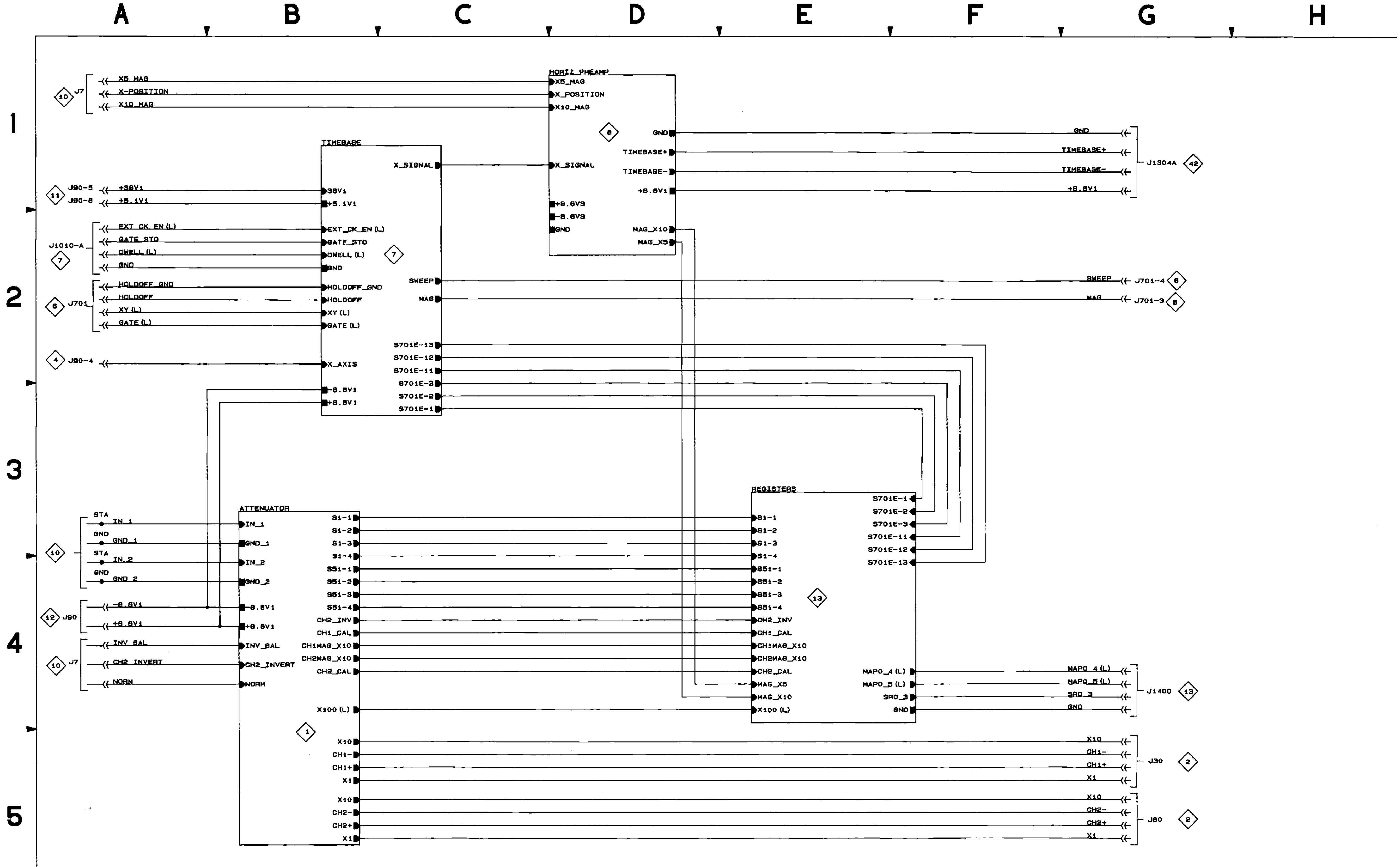
Assembly A1

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J1	2A	5A	J4	5A	8A	J6	2H	9A	W996	4A	5D
J3	3A	7A	J5	3A	8A						

Partial A1 also shown on diagrams 2, 3, 4, 5, 6, 9, 11, 12 and 13.



A
B
C
D
E
F
G
H
1
2
3
4
5
VERTICAL PREAMP
X1
CH1+
CH1-
X10
-8.6V5
CH2+
CH2-
+8.6V5
CH2_POS-
CH2_POS+
CH2 (L)
CH1 (L)
CHOPEN (L)
ALT_SYNC (L)
XY (L)
CH1_POS+
CH1_POS-
+8.6V1
CH1_ACQ-
CH1_ACQ+
AGND
-8.6VY
CH2_ACQ+
CH2_ACQ-
+8.6VY
GND1
VDAC+
VDAC-
-8.6V1
+CH1
-CH1
+CH2
-CH2
VDAC_EN
CH2_SEL
CH1_SEL
CHOP_BLANK
CH1/CH2-
CH1/CH2+
W30
W80
J2
J1
J3
J5
J6-1
J6-2
X1
CH1+
CH1-
X10
-8.6V5
CH2+
CH2-
+8.6V5
CH2 POS-
CH2 POS+
CH2 (L)
CH1 (L)
CHOPEN (L)
REF POSITION
GND
BEAM FIND SW
CH1 AC (L)
XY
CH1 POS+
CH1 POS+
J1301-6
CR YDAC EN
W1005-1
REF POS (L)
-8.6V1
+8.6V1
SLOPE
TRIG LEVEL1
TRIG LEVEL2
TRIG LEVEL3
CH1 EN (L)
CH2 EN (L)
TVF (L)
P-P AUTO (L)
EXT TRIG
GND
VERTICAL OUTPUT AMPLIFIER
CH1/CH2-
CH1/CH2+
+8.6V1
-8.6V1
GND
BEAM_FIND_SW
REF_POSITION
CR_YDAC_EN
REF_POSITION (L)
+36V2
REF_SEP
Y_LHS
Y_RHS
TRIG CONTROL
CH2 (L)
CH1 (L)
CH2_SEL
CH1_SEL
TRIG_ANALOGUE
ALT_VERT (L)
CH1_EN (L)
CH2_EN (L)
TVF (L)
P-P_AUTO (L)
EXT_TRIG
GND
CHOPEN (L)
TRIGGER
SLOPE
XY
GND
AC_TRIG (L)
LF_REJ (L)
DC_TRIG (L)
P-P_AUTO (L)
LF_REJ (L)
TVF (L)
HF_REJ (L)
DC
CH1_TRIG
CH2_TRIG
TRIGGER
XY.B
P-P_AUTO (L)
LF_REJ (L)
HF_REJ (L)
XY (L)
+CH1
-CH1
+CH2
-CH2
EXTEN (L)
EXT_TRIG
DC
CH1_TRIG
CH2_TRIG
TRIGGER_ANALOGUE
XY.B
TRIG_LVL+
TRIG_LVL-
X_AXIS
TRIG_LEVEL1
TRIG_LEVEL2
TRIG_LEVEL3
P-P AUTO (L)
LF REJ (L)
X AXIS
W90-4
J1002
+8.6V1
CH ACQ-
CH1 ACQ+
AGND
-8.6VY
CH2 ACQ+
CH2 ACQ-
+8.6VY
W1306
GND
VDAC+
VDAC-
-8.6V1
J6
GND
AC TRIG (L)
LF REJ (L)
DC TRIG (L)
ALT VERT (L)
W1005-4
CH1 TRIG
W1005-6
CH2 TRIG
W1005-5
W996
GND
GND
SWEEP LOGIC
ALT_SYNC (L)
TRIGGER
XY (L)
HOLDOFF_GND
HOLDOFF
SWEEP
RESET
SINGLE_SWEEP (L)
XY
MAG
GATE (L)
SGL_SWP (L)
GATE
ENA_TRIG_SS (L)
P-P_AUTO (L)
XY (L)
READY_TRIG'D
W1008-2
XY (L)
W701
HOLD OFF GND
HOLD OFF
SWEEP
J5-3
RESET
J5-4
SINGLE SWEEP (L)
XY
J1-4
MAG
J701-3
GATE (L)
W701-6
SGL SWP (L)
J5-4
GATE
J1007-1
ENA TRIG SS
W1008-4
P-P AUTO (L)
J5-6
XY (L)
J701-5
READY TRIG'D
J4-5
W1306-8
FAST_NS_Z
J4-3
MAG X10
W1301-8
CR YDAC EN
W1007-2
STORE
J1306-18
COMP Z (L)
HIGH VOLTAGE AND CRT
CHOP_BLANK
VDAC_EN
Y_LHS
Y_RHS
STORE
COMP_Z (L)
XY (L)
FAST_NS_Z (L)
MAG_X10
CR_YDAC_EN
BEAM_FIND
X_RHS
X_LHS
1.8KV
100V AC
HV CORRECTION
EXT_Z
TR
GND
HTR-1
HTR-14
EXT Z
J4-6
TR
J987-2
GND
J987-1
POWER SUPPLY
LINE_SYNC
+38V2
+38V1
+100V2
+100V1
+5.1V1
-5.1V1
+8.6VX
HTR-1
HTR-14
HV CORRECTION
100V AC
1.8KV
LINE SYNC
J6-6
+38V1
W90-5
J1006-3
+5.1V1
W1006-2
W1006-1
-5.1V1
W1006-4
+8.6VX
W1006-5
HORIZONTAL OUTPUT AMPLIFIER
BEAM_FIND_SW (L)
GND
X+
X-
GND
100V2
BEAM_FIND
X_RHS
X_LHS
W1301
GND
X+
X-
GND
*NOTE: SEE DIAG NUMBER SHOWN FOR SIGNAL PATH TO AND FROM.
J1, J2, J4, J5 & J6 ARE WIRE TRAP CONNECTORS ON THE A1 BOARD.
2211
7234-14
A1 INTERCONNECT
14



2211

7234-15

A2 INTERCONNECT 15

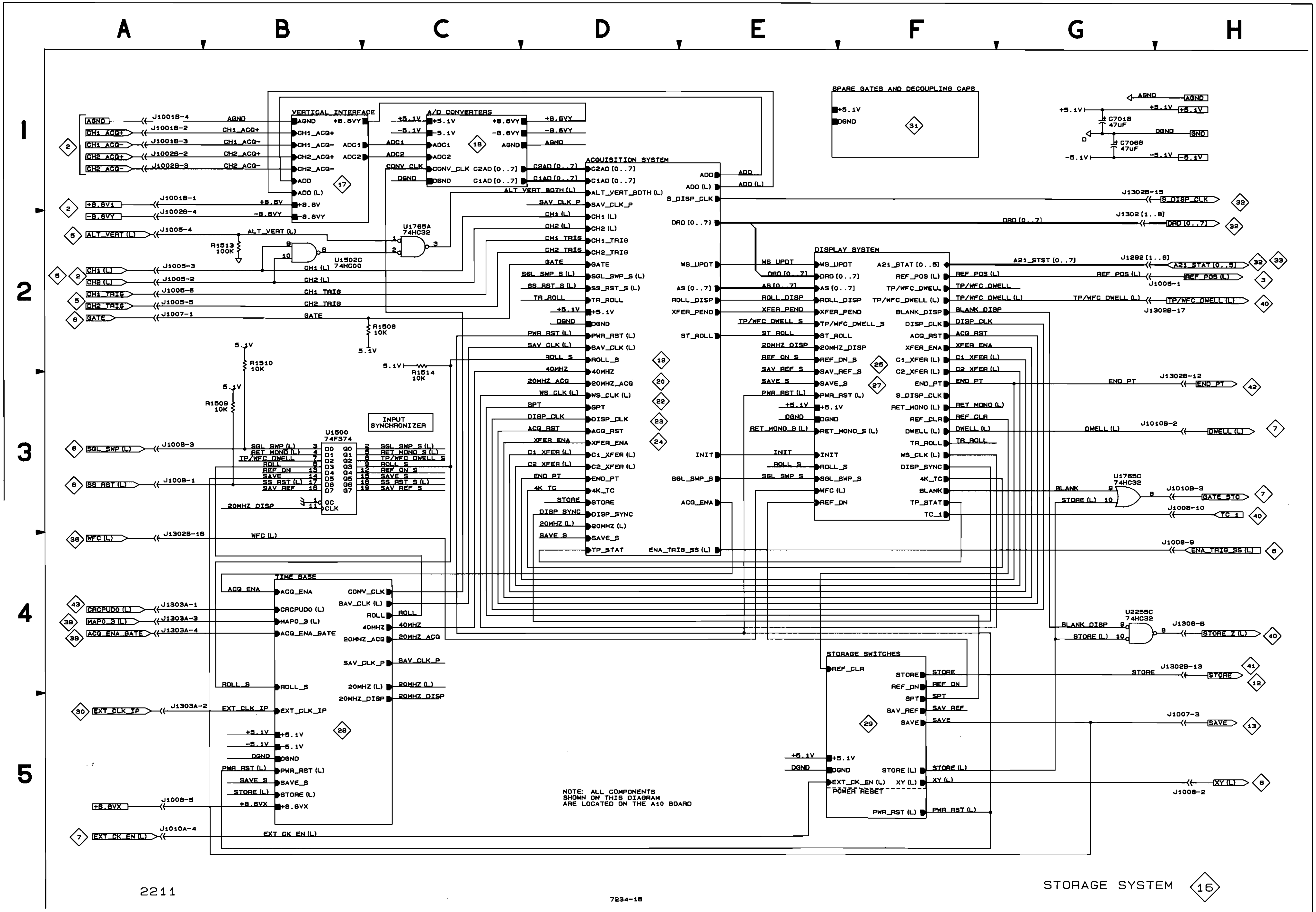
A2 INTERCONNECT 15

STORAGE SYSTEM DIAGRAM 16

Assembly A10

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C7018	1G	8K	R1509	3B	8G				U1765A	2C	8H
C7066	1G	8L	R1510	2B	7J	U1500	3B	5H	U1765C	3G	8H
			R1513	2B	8H	U1502C	2B	8G	U2255C	4G	7E
R1508	2C	8D	R1514	2C	5J						

Partial A10 also shown on diagrams 17, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29, 30 and 31.



2211

STORAGE SYSTEM 16

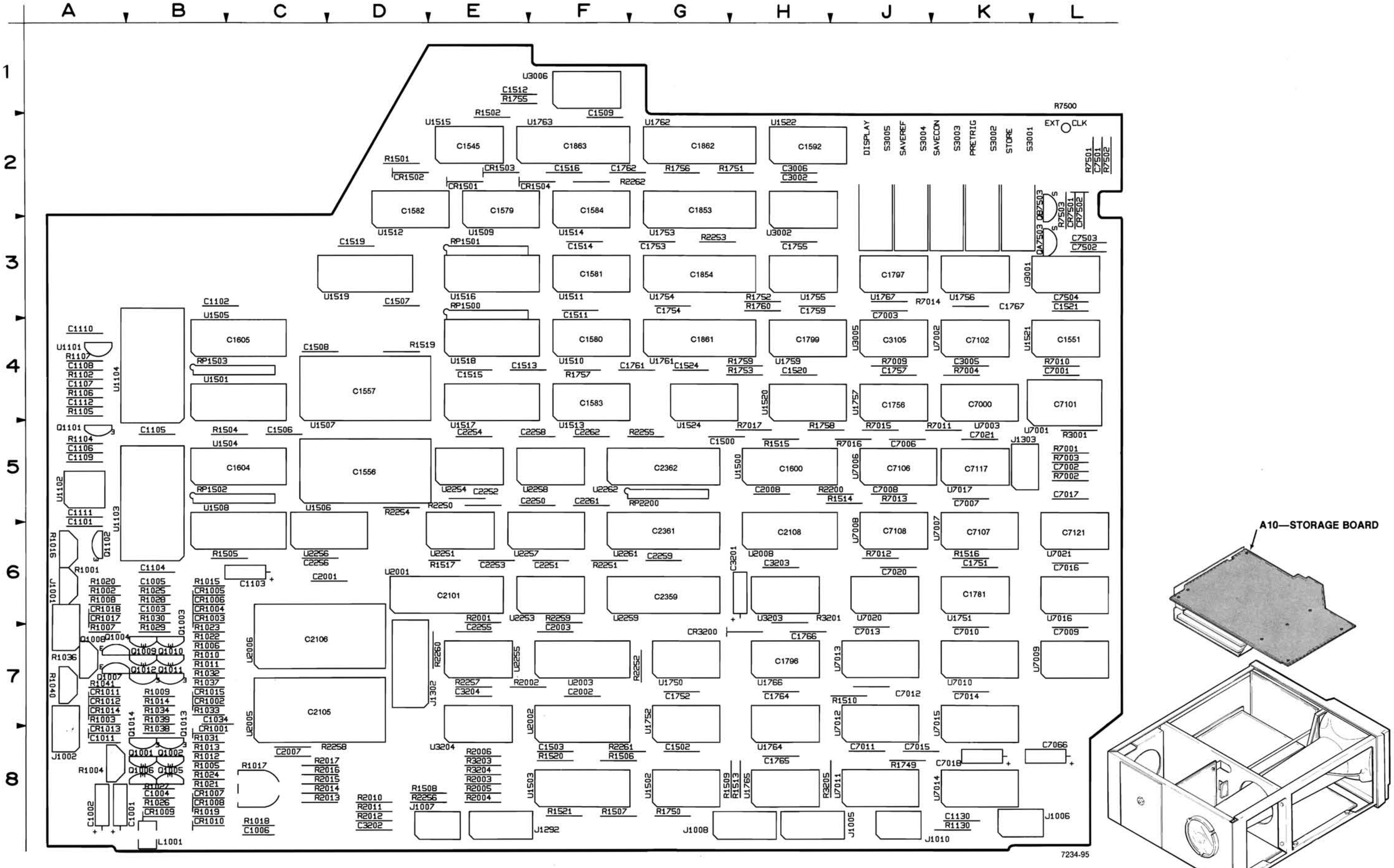
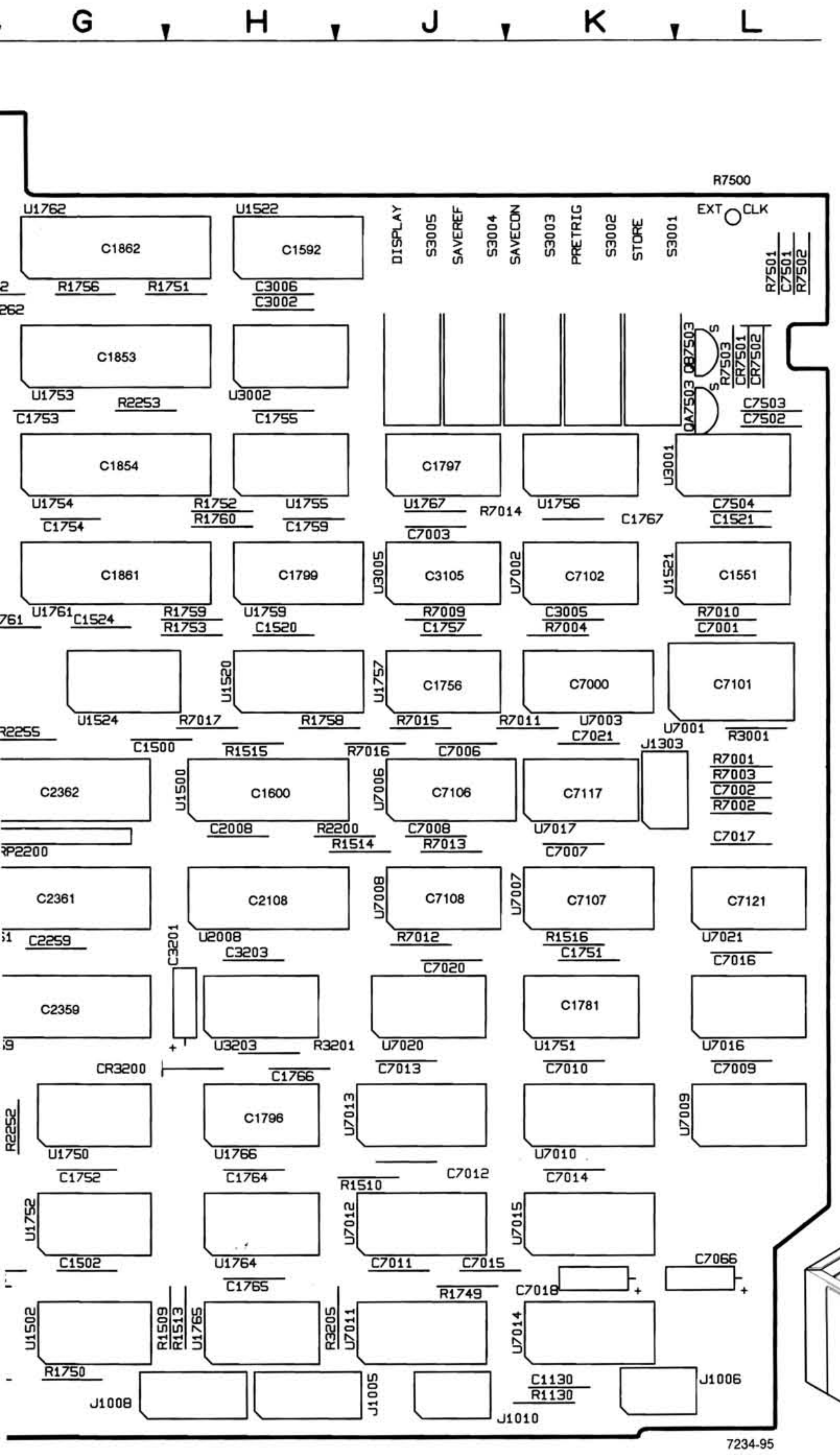
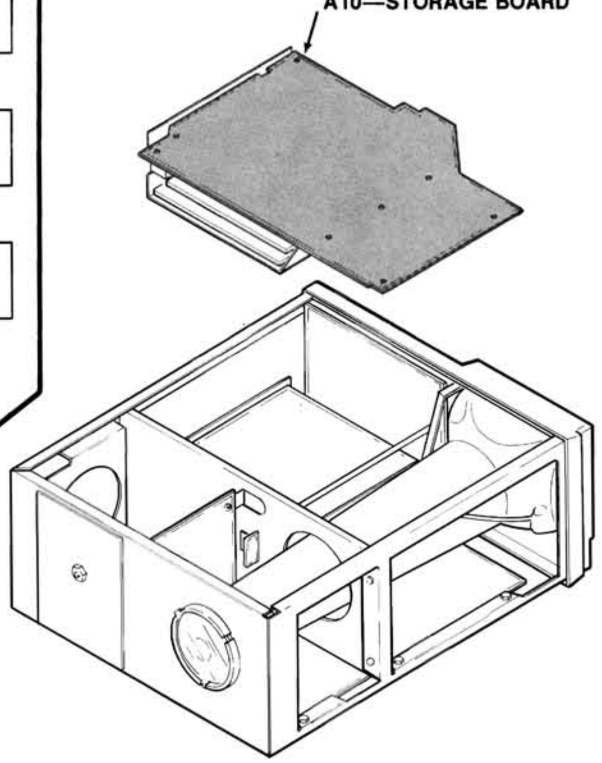


Figure 9-12. A10—Storage board.



board.

A10—STORAGE BOARD



A10—STORAGE BOARD

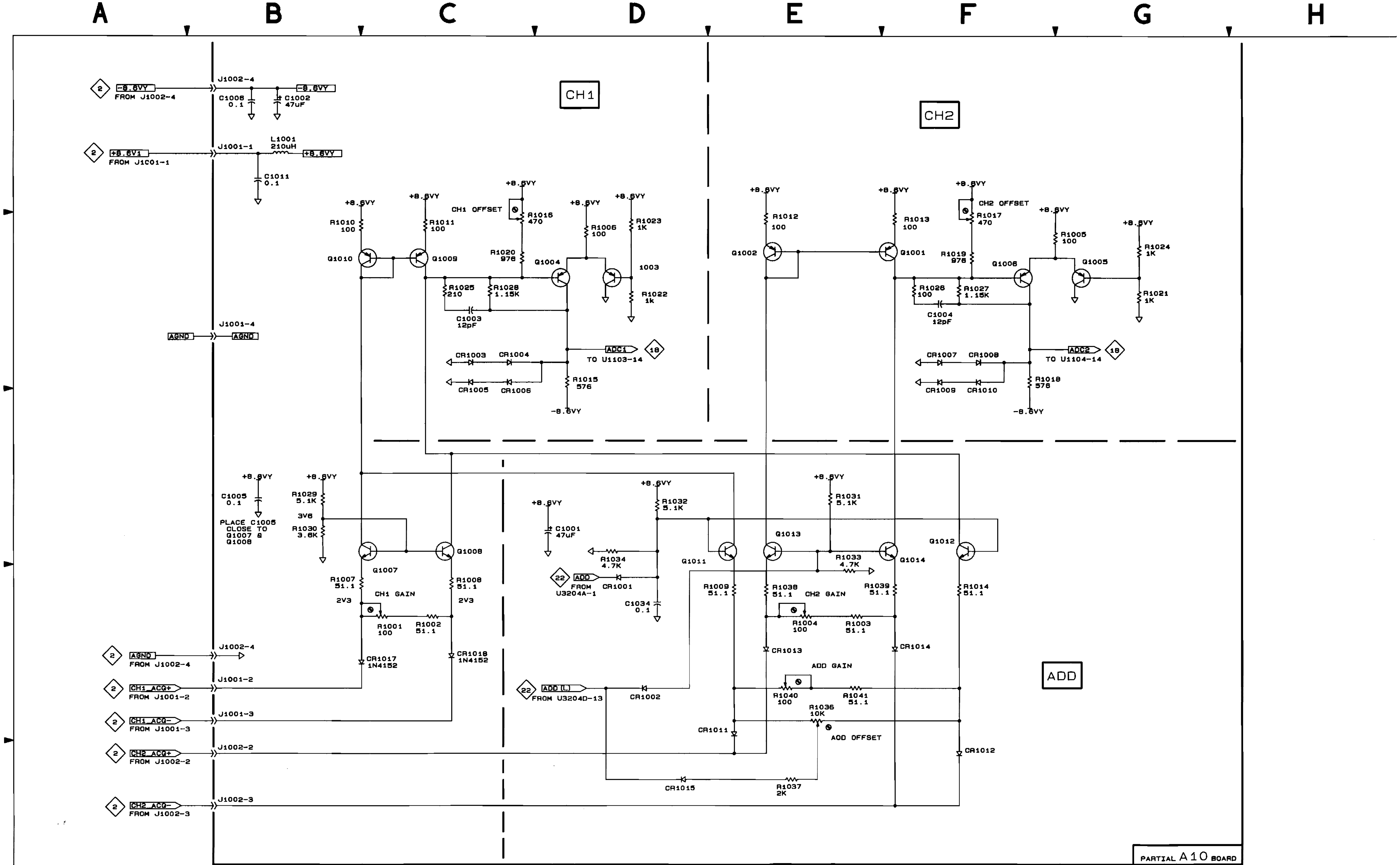
CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
C1001	17	C1863	31	CR1008	17	R1025	17	R2259	25	U1750	25
C1002	17	C2001	31	CR1009	17	R1026	17	R2260	30	U1751	19
C1003	17	C2002	31	CR1010	17	R1027	17	R2261	25	U1752	19
C1004	17	C2003	31	CR1011	17	R1028	17	R2262	25	U1753	19
C1005	17	C2004	27	CR1012	17	R1029	17	R3001	29	U1754	19
C1006	17	C2005	27	CR1013	17	R1030	17	R3201	29	U1755	20
C1011	17	C2006	27	CR1014	17	R1031	17	R3203	22	U1756	20
C1034	17	C2007	31	CR1015	17	R1032	17	R3204	22	U1757	20
C1101	18	C2008	31	CR1017	17	R1033	17	R3205	27	U1759	20
C1102	18	C2101	31	CR1018	17	R1034	17	R7001	28	U1761	19
C1103	18	C2105	31	CR1501	24	R1036	17	R7002	28	U1762	19
C1104	18	C2106	31	CR1502	24	R1037	17	R7003	28	U1763	19
C1105	18	C2108	31	CR1503	24	R1038	17	R7004	28	U1764	19
C1106	18	C2250	25	CR1504	24	R1039	17	R7009	28	U1764	25
C1107	18	C2251	25	CR3200	29	R1040	17	R7010	28	U1765	16
C1108	18	C2252	31	CR7501	28	R1041	17	R7011	28	U1765	19
C1109	18	C2253	31	CR7502	28	R1102	18	R7012	28	U1765	25
C1110	18	C2254	31			R1104	18	R7013	28	U1766	19
C1111	18	C2255	31	J1001	30	R1105	18	R7014	28	U1766	25
C1112	18	C2256	31	J1002	30	R1106	18	R7015	28	U1766	27
C1130	28	C2258	31	J1005	30	R1107	18	R7016	28	U1767	28
C1500	31	C2259	31	J1006	30	R1130	28	R7017	28	U2001	27
C1502	31	C2261	31	J1007	30	R1501	24	R7500	30	U2002	27
C1503	31	C2262	31	J1008	30	R1502	24	R7501	28	U2003	27
C1506	31	C2359	31	J1010	30	R1504	22	R7502	28	U2005	27
C1507	31	C2361	31	J1292	30	R1505	22	R7503	28	U2006	27
C1508	31	C2362	31	J1302	30	R1506	22			U2008	25
C1509	31	C3002	31	J1303	30	R1507	22	RP1500	23	U2251	25
C1511	31	C3005	31			R1508	16	RP1501	23	U2251	27
C1512	31	C3006	31	L1001	17	R1509	16	RP1502	22	U2253	22
C1513	31	C3105	31			R1510	16	RP1503	22	U2253	25
C1514	31	C3201	29	Q1001	17	R1513	16	RP2200	25	U2254	25
C1515	31	C3202	29	Q1002	17	R1514	16			U2255	16
C1516	31	C3203	31	Q1003	17	R1515	22	S3001	29	U2255	25
C1519	31	C3204	31	Q1004	17	R1516	22	S3002	29	U2255	27
C1520	31	C7000	31	Q1005	17	R1517	22	S3003	28	U2255	31
C1521	31	C7001	31	Q1006	17	R1519	22	S3003	29	U2256	25
C1524	31	C7002	28	Q1007	17	R1520	22	S3004	29	U2257	25
C1545	31	C7003	31	Q1008	17	R1521	22	S3005	29	U2258	25
C1551	31	C7006	31	Q1009	17	R1749	25			U2259	25
C1556	31	C7007	31	Q1010	17	R1750	19	U1101	18	U2261	25
C1557	31	C7008	31	Q1011	17	R1751	19	U1102	18	U2262	25
C1579	31	C7009	31	Q1012	17	R1752	19	U1103	18	U3001	29
C1580	31	C7010	31	Q1013	17	R1753	19	U1104	18	U3002	19
C1581	31	C7011	31	Q1014	17	R1755	19	U1500	16	U3002	29
C1582	31	C7012	31	Q1101	18	R1756	19	U1501	22	U3005	28
C1583	31	C7013	31	Q1102	18	R1757	19	U1502	16	U3005	29
C1584	31	C7014	31	Q7503A	28	R1758	20	U1502	25	U3006	22
C1592	31	C7015	31	Q7503B	28	R1759	20	U1502	27	U3006	29
C1600	31	C7016	31			R1760	20	U1503	22	U3203	27
C1604	31	C7017	31	R1001	17	R2001	27	U1504	22	U3203	28
C1605	31	C7018	16	R1002	17	R2002	27	U1505	22	U3203	29
C1751	31	C7020	31	R1003	17	R2003	27	U1506	22	U3204	22
C1752	31	C7021	31	R1004	17	R2004	27	U1507	22	U3204	29
C1753	31	C7066	16	R1005	17	R2005	27	U1508	22	U3204	31
C1754	31	C7101	31	R1006	17	R2006	27	U1509	24	U7001	28
C1755	31	C7102	31	R1007	17	R2010	30	U1510	24	U7002	20
C1756	31	C7106	31	R1008	17	R2011	30	U1511	24	U7002	28
C1757	31	C7107	31	R1009	17	R2012	30	U1512	24	U7003	28
C1759	31	C7108	31	R1010	17	R2013	30	U1513	24	U7006	28
C1761	31	C7117	31	R1011	17	R2014	30	U1514	24	U7007	28
C1762	31	C7121	31	R1012	17	R2015	30	U1515	23	U7008	28
C1764	31	C7501	28	R1013	17	R2016	30	U1516	23	U7009	28
C1765	31	C7502	28	R1014	17	R2017	30	U1517	23	U7010	28
C1766	31	C7503	28	R1015	17	R2200	25	U1518	23	U7011	28
C1767	31	C7504	28	R1016	17	R2250	25	U1519	23	U7012	28
C1781	31			R1017	17	R2251	25	U1520	22	U7013	28
C1796	31	CR1001	17	R1018	17	R2252	25	U1521	28	U7014	28
C1797	31	CR1002	17	R1019	17	R2253	25	U1521	31	U7015	28
C1799	31	CR1003	17	R1020	17	R2254	25	U1522	24	U7016	28
C1853	31	CR1004	17	R1021	17	R2255	25	U1524	20	U7017	28
C1854	31	CR1005	17	R1022	17	R2256	27	U1524	22	U7020	28
C1861	31	CR1006	17	R1023	17	R2257	30	U1524	25	U7021	28
C1862	31	CR1007	17	R1024	17	R2258	25	U1750	19		

VERTICAL INTERFACE DIAGRAM 17

Assembly A10

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1001	3D	8B	CR1013	4E	8A	Q1014	3E	8B	R1020	2C	6A
C1002	1B	8A	CR1014	4F	7A				R1021	2G	8B
C1003	2C	6B	CR1015	5D	7B	R1001	4C	6A	R1022	2D	7B
C1004	2F	8B	CR1017	4B	6A	R1002	4C	6A	R1023	2D	7B
C1005	3B	6B	CR1018	4C	6A	R1003	4E	7A	R1024	2G	8B
C1006	1B	8C				R1004	4E	8A	R1025	2C	6B
C1011	1B	8A	L1001	1B	8B	R1005	2F	8B	R1026	2F	8B
C1034	4D	7B				R1006	2D	7B	R1027	2F	8B
			Q1001	2E	8B	R1007	4B	7A	R1028	2C	6B
CR1001	4D	8B	Q1002	2E	8B	R1008	4C	6A	R1029	3B	7B
CR1002	4D	7B	Q1003	2D	7B	R1009	4E	7B	R1030	3B	6B
CR1003	2C	6B	Q1004	2D	7A	R1010	2B	7B	R1031	3E	8B
CR1004	2C	6B	Q1005	2G	8B	R1011	2C	7B	R1032	3D	7B
CR1005	2C	6B	Q1006	2F	8B	R1012	2E	8B	R1033	4E	7B
CR1006	2C	6B	Q1007	3B	7A	R1013	2F	8B	R1034	3D	7B
CR1007	2F	8B	Q1008	3C	7A	R1014	4F	7B	R1036	4E	7A
CR1008	2F	8B	Q1009	2C	7B	R1015	2D	6B	R1037	5E	7B
CR1009	2F	8B	Q1010	2B	7B	R1016	2C	6A	R1038	4E	8B
CR1010	2F	8B	Q1011	3E	7B	R1017	2F	8C	R1039	4F	7B
CR1011	4E	7A	Q1012	3F	7B	R1018	2F	8C	R1040	4E	7A
CR1012	5F	7A	Q1013	3E	8B	R1019	2F	8B	R1041	4E	7A

Partial A10 also shown on diagrams 16, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29, 30 and 31.



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VERTICAL INTERFACE 17

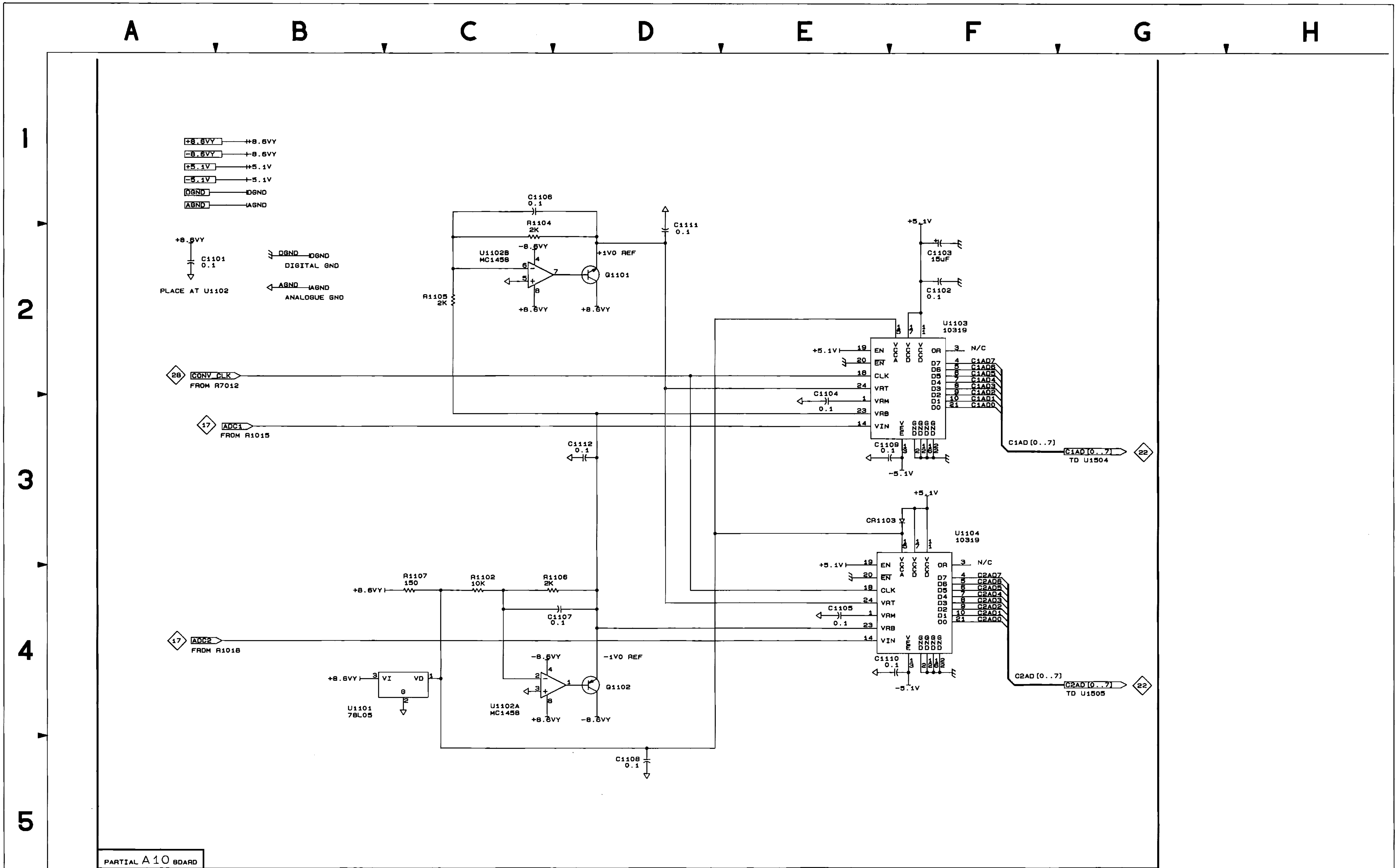
7234-17

A/D CONVERTERS AND REFERENCES DIAGRAM 18

Assembly A10

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1101	2A	5A	C1108	5D	4A	Q1102	4D	6A			
C1102	2F	3B	C1109	3E	5A				U1101	4B	4A
C1103	2F	6C	C1110	4F	4A	R1102	4C	4A	U1102A	4C	5A
C1104	3E	6B	C1111	2D	5A	R1104	2C	5A	U1102B	2C	5A
C1105	4E	5B	C1112	3D	4A	R1105	2C	4A	U1103	2E	5A
C1106	1C	5A				R1106	4C	4A	U1104	3E	4A
C1107	4D	4A	Q1101	2D	5A	R1107	4C	4A			

Partial A10 also shown on diagrams 16, 17, 19, 20, 22, 23, 24, 25, 27, 28, 29, 30 and 31.



PARTIAL A10 BOARD

2211

A/D CONVERTERS AND REFERENCES 18

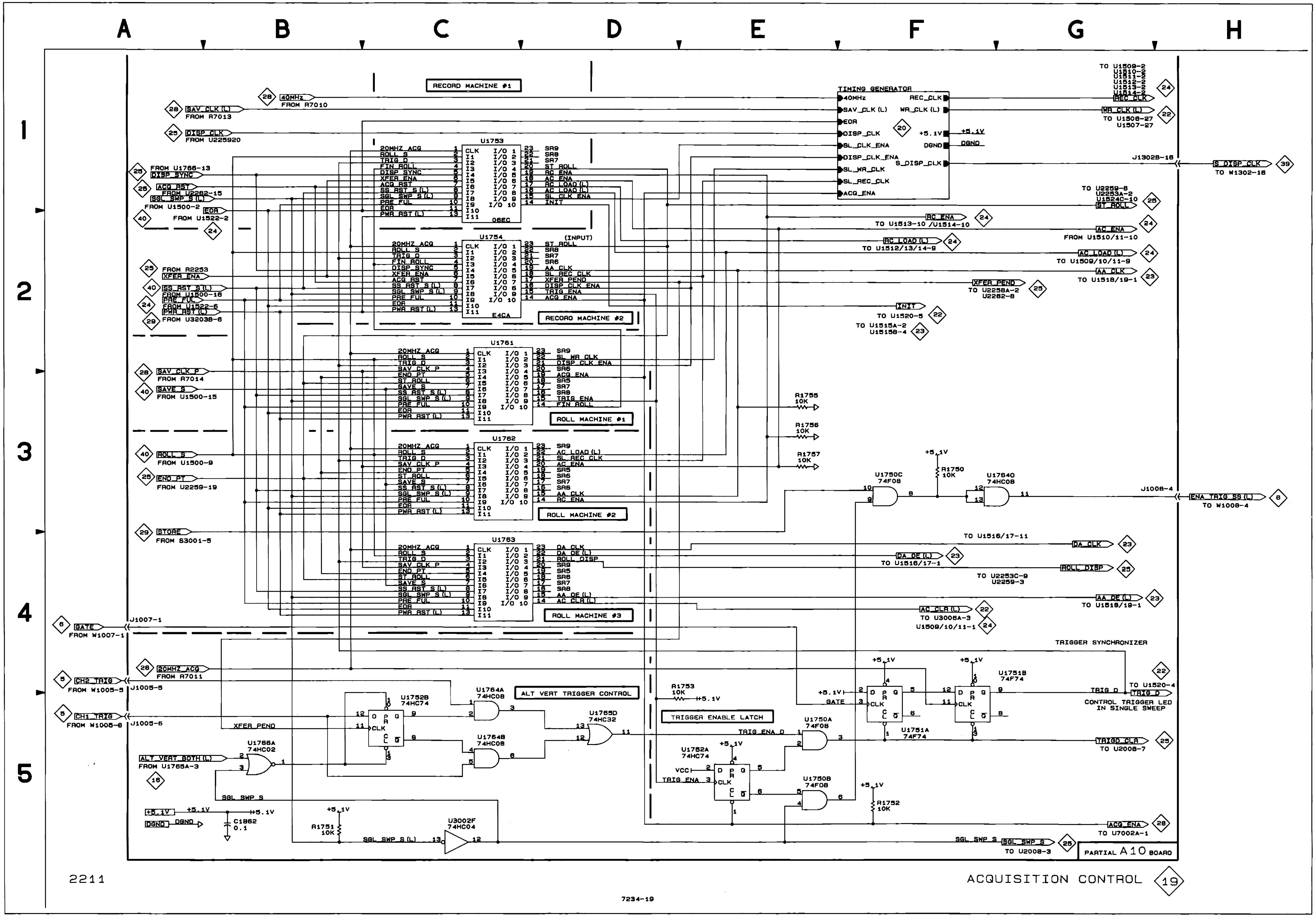
7234-18

ACQUISITION CONTROL DIAGRAM 19

Assembly A10

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1750	3F	8G	U1750A	5E	7G	U1752B	5C	7G	U1764A	5C	8H
R1751	5B	2G	U1750B	5E	7G	U1753	1C	3G	U1764B	5C	8H
R1752	5F	3H	U1750C	3F	7G	U1754	2C	3G	U1764D	3F	8H
R1753	5D	4H	U1751A	4F	6K	U1761	2C	4G	U1765D	5D	8H
R1755	3E	1E	U1751B	4F	6K	U1762	3C	2G	U1766A	5B	7H
R1756	3E	2G	U1752A	5E	7G	U1763	4C	2F	U3002F	5C	3H
R1757	3E	4F									

Partial A10 also shown on diagrams 16, 17, 18, 20, 22, 23, 24, 25, 27, 28, 29, 30 and 31.

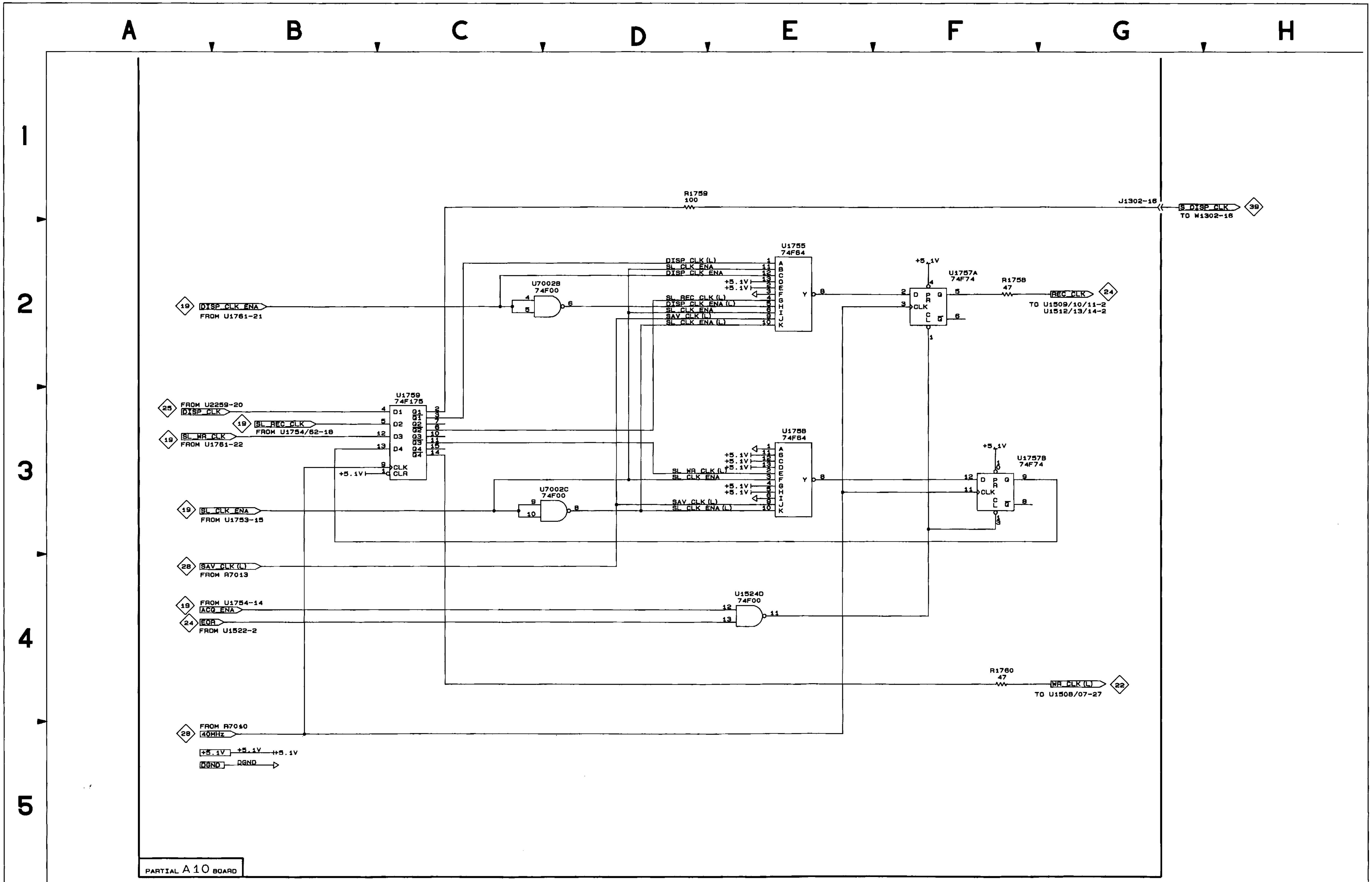

RECORD MACHINE #1
RECORD MACHINE #2
ROLL MACHINE #1
ROLL MACHINE #2
ROLL MACHINE #3
TIMING GENERATOR
ALT VERT TRIGGER CONTROL
TRIGGER ENABLE LATCH
TRIGGER SYNCHRONIZER
PARTIAL A10 BOARD

ACQUISITION TIMING GENERATOR DIAGRAM 20

Assembly A10

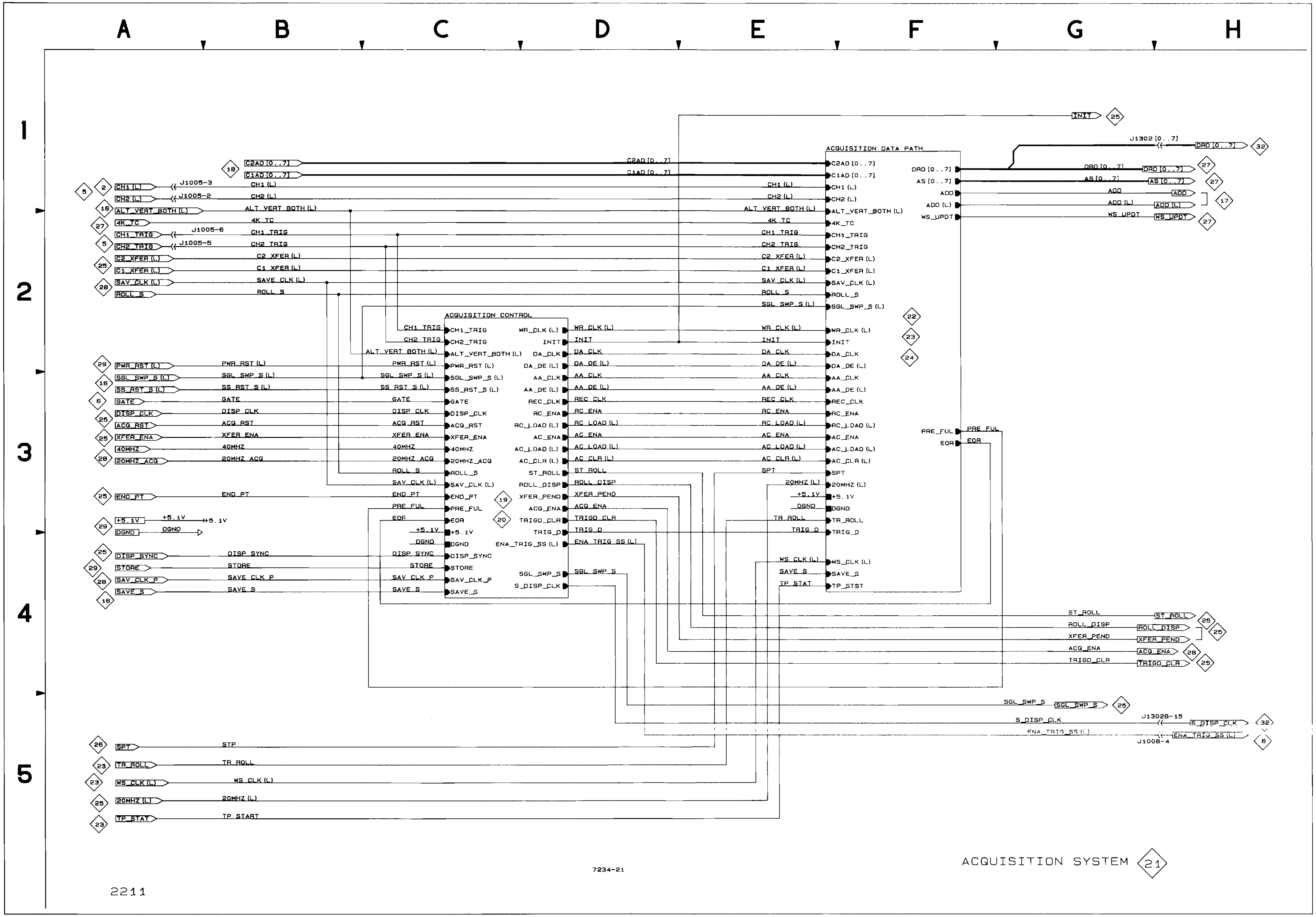
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1758	2F	5H	U1524D	4E	5G	U1757A	2F	4J	U7002B	2C	4K
R1759	1D	4H	U1755	2E	3H	U1757B	3F	4J	U7002C	3C	4K
R1760	4F	3H	U1756	3E	3K	U1759	3C	4H			

Partial A10 also shown on diagrams 16, 17, 18, 19, 22, 23, 24, 25, 27, 28, 29, 30 and 31.



ACQUISITION TIMING GENERATOR 20

7234-20



ACQUISITION SYSTEM 21

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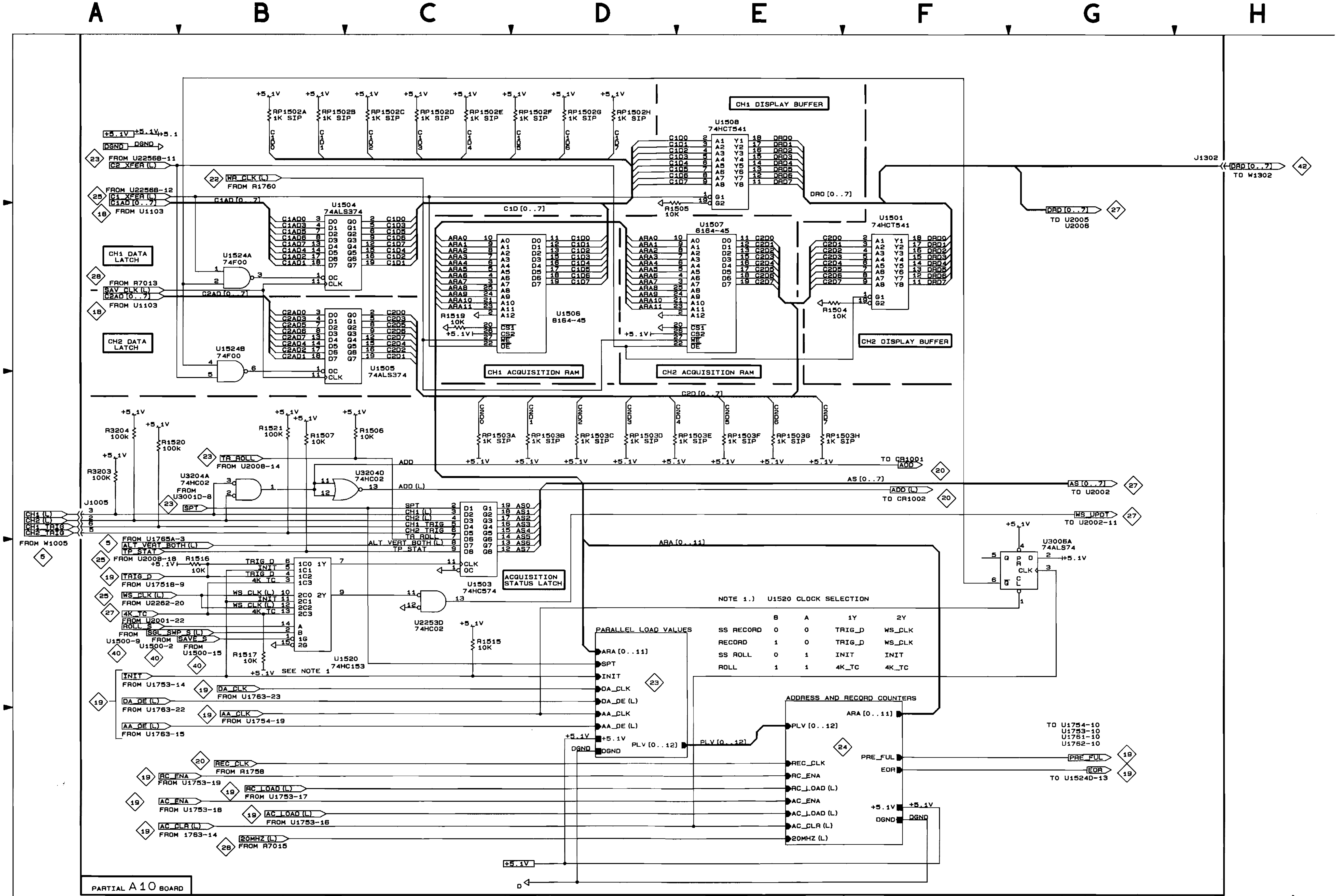
ACQUISITION DATA PATH DIAGRAM 22

Assembly A10

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1504	2E	5B	R3204	3A	8E	RP1503B	3D	4B	U1505	2B	3B
R1505	1D	6B				RP1503C	3D	4B	U1506	2C	5C
R1506	3C	8F	RP1502A	1B	5B	RP1503D	3D	4B	U1507	2E	5C
R1507	3B	8F	RP1502B	1B	5B	RP1503E	3D	4B	U1508	1E	5B
R1515	4C	5H	RP1502C	1C	5B	RP1503F	3E	4B	U1520	4B	4H
R1516	4B	6K	RP1502D	1C	5B	RP1503G	3E	4B	U1524A	2B	5G
R1517	4B	6E	RP1502E	1C	5B	RP1503H	3E	4B	U1524B	2B	5G
R1519	2C	4D	RP1502F	1C	5B				U2253D	4C	6E
R1520	3A	8F	RP1502G	1D	5B	U1501	2F	4B	U3006A	4F	1F
R1521	3B	8F	RP1502H	1D	5B	U1503	3C	8F	U3204A	3B	8E
R3203	3A	8E	RP1503A	3C	4B	U1504	2B	5B	U3204D	3B	8E

Partial A10 also shown on diagrams 16, 17, 18, 19, 20, 23, 24, 25, 27, 28, 29, 30 and 31.



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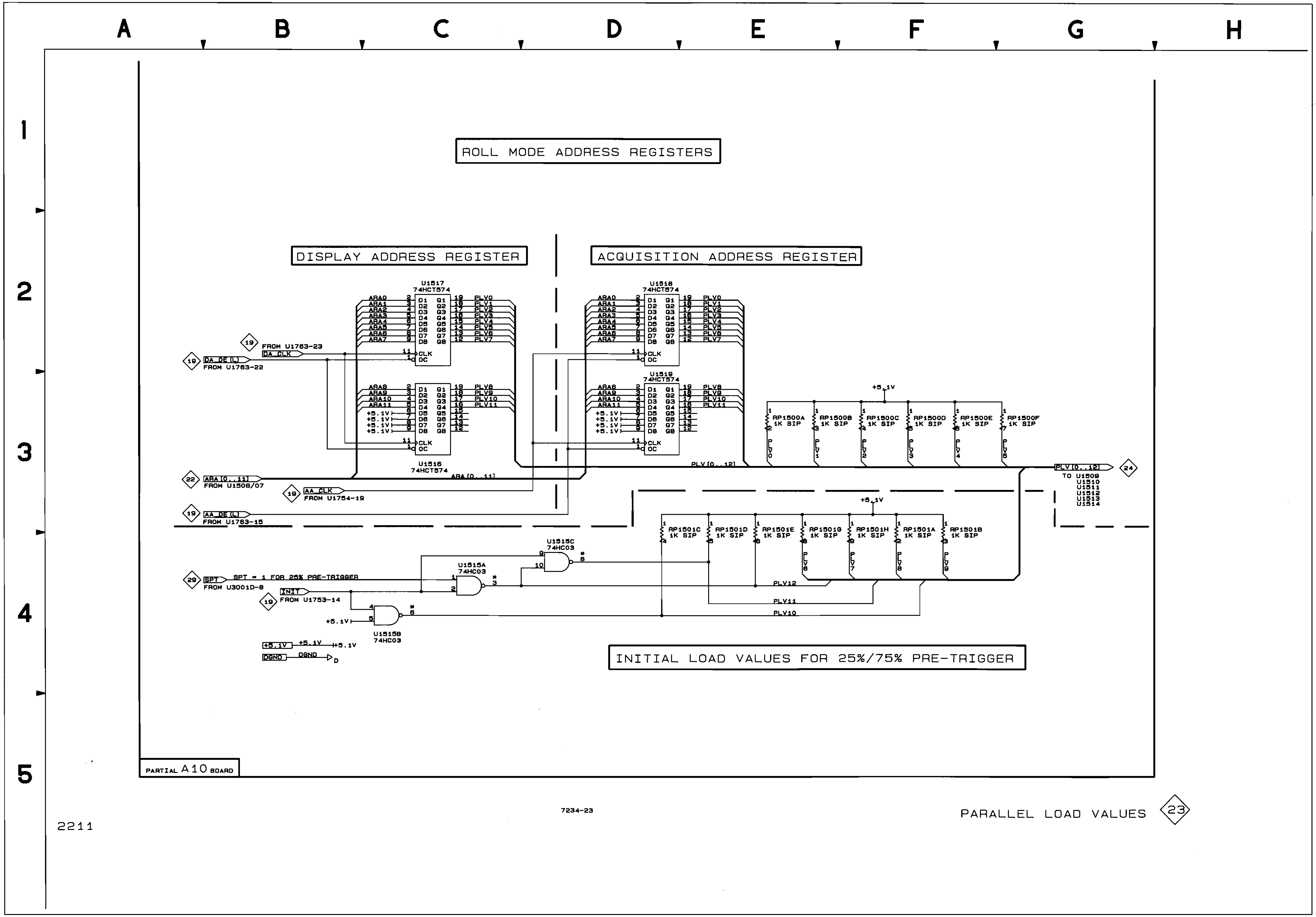
ACQUISTION DATA PATH 22

PARALLEL LOAD VALUES DIAGRAM 23

Assembly A10

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
RP1500A	3E	3E	RP1501A	3F	3E	RP1501G	3E	3E	U1515C	4D	2E
RP1500B	3E	3E	RP1501B	3F	3E	RP1501H	3F	3E	U1516	3C	3E
RP1500C	3F	3E	RP1501C	3D	3E				U1517	2C	5E
RP1500D	3F	3E	RP1501D	3E	3E	U1515A	4C	2E	U1518	2D	4E
RP1500E	3F	3E	RP1501E	3E	3E	U1515B	4C	2E	U1519	3D	3D
RP1500F	3G	3E									

Partial A10 also shown on diagrams 16, 17, 18, 19, 20, 22, 24, 25, 27, 28, 29, 30 and 31.


ROLL MODE ADDRESS REGISTERS
DISPLAY ADDRESS REGISTER
ACQUISITION ADDRESS REGISTER
U1517 74HCT574
U1516 74HCT574
U1518 74HCT574
U1519 74HCT574
FROM U1763-23
DA_CLK
DA_OE(L)
FROM U1763-22
ARA[0..11]
FROM U1506/07
AA_CLK
FROM U1754-19
AA_OE(L)
FROM U1763-15
PLV[0..12]
TO U1509 U1510 U1511 U1512 U1513 U1514
SPT
FROM U3001D-8
SPT = 1 FOR 25% PRE-TRIGGER
INIT
FROM U1753-14
U1515A 74HC03
U1515B 74HC03
U1515C 74HC03
+5.1V
DGND
INITIAL LOAD VALUES FOR 25%/75% PRE-TRIGGER
PARTIAL A10 BOARD

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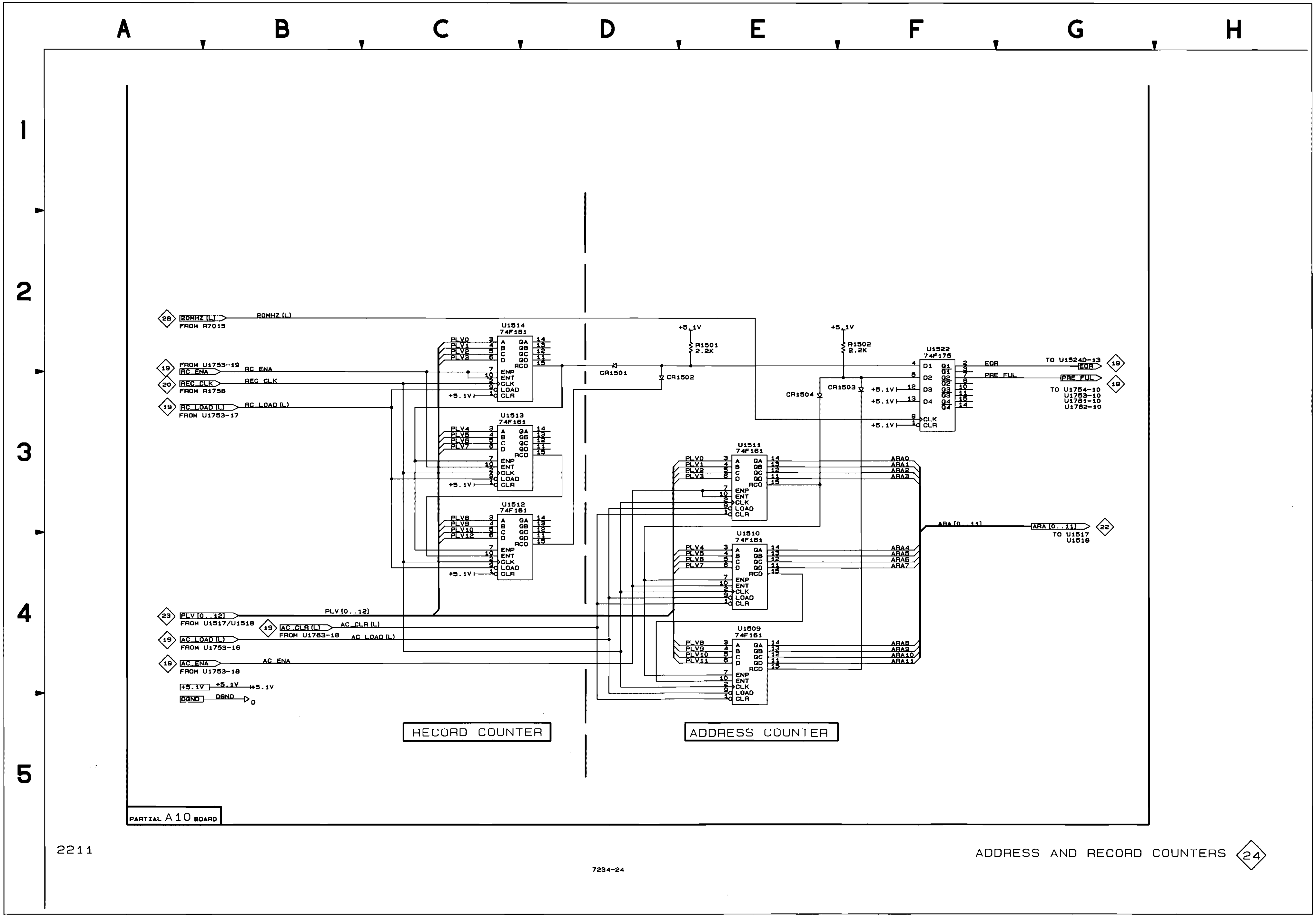
ADDRESS AND RECORD COUNTERS DIAGRAM 24

Assembly A10

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
CR1501	2D	2E	R1501	2E	2D	U1510	4E	4F	U1513	3C	5F
CR1502	3D	2D	R1502	2F	2E	U1511	3E	3F	U1514	2C	3F
CR1503	3F	2E				U1512	3C	3D	U1522	2F	2H
CR1504	3E	2E	U1509	4E	3E						

Partial A10 also shown on diagrams 16, 17, 18, 19, 20, 22, 23, 25, 27, 28, 29, 30 and 31.

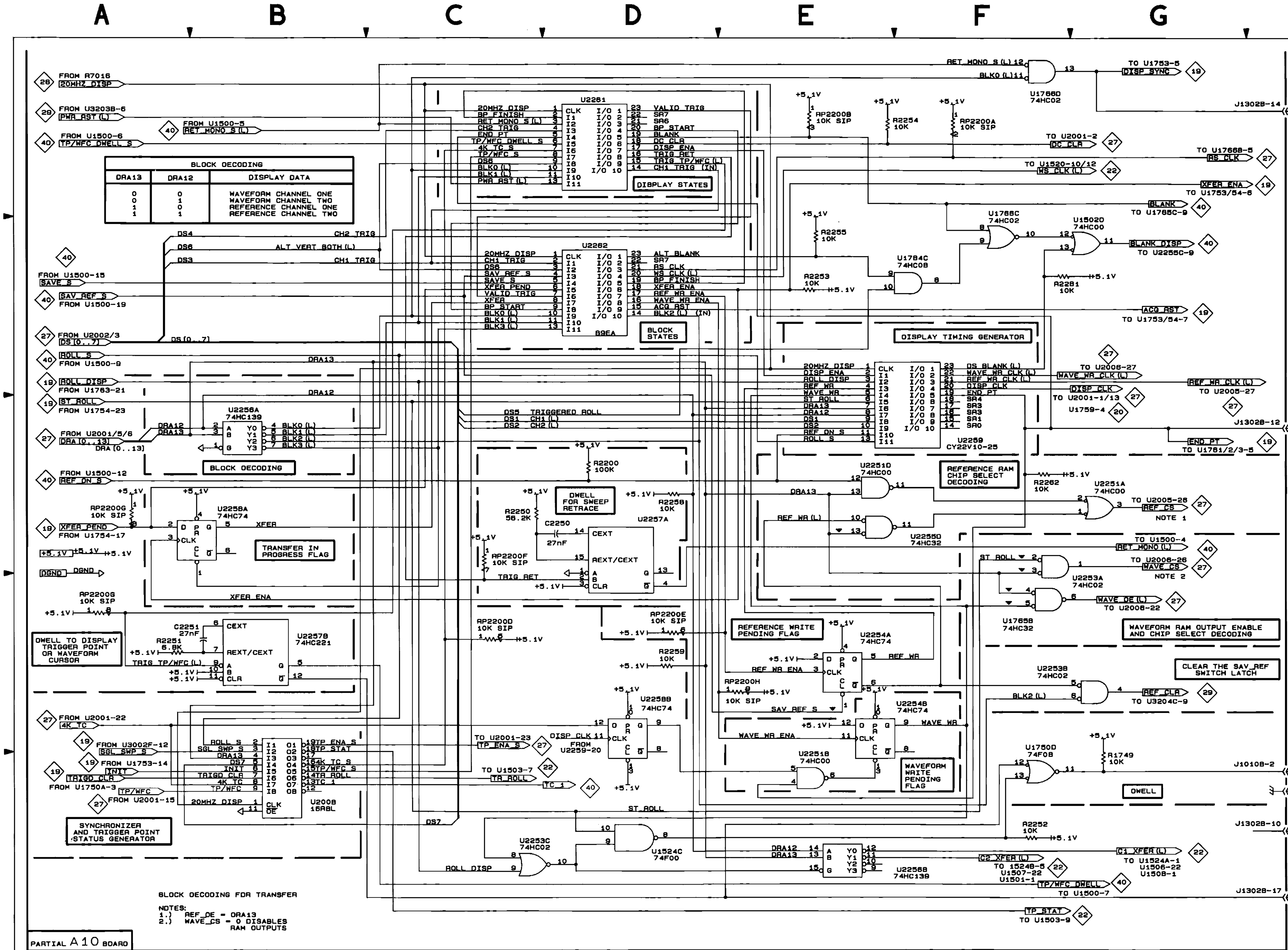

20MHZ (L)
FROM R7015
U1514
74F161
U1513
74F161
U1512
74F161
FROM U1753-19
RC ENA
REC CLK
FROM R1758
RC LOAD (L)
FROM U1753-17
+5.1V
R1501
2.2K
CR1501
CR1502
R1502
2.2K
CR1503
CR1504
U1522
74F175
TO U1524D-13
EOR
PRE FUL
TO U1754-10
U1753-10
U1761-10
U1782-10
U1511
74F161
U1510
74F161
U1509
74F161
ARA [0..11]
TO U1517
U1518
PLV [0..12]
FROM U1517/U1518
AC CLR (L)
FROM U1763-18
AC LOAD (L)
FROM U1753-16
AC ENA
FROM U1753-18
DGND
RECORD COUNTER
ADDRESS COUNTER
PARTIAL A10 BOARD

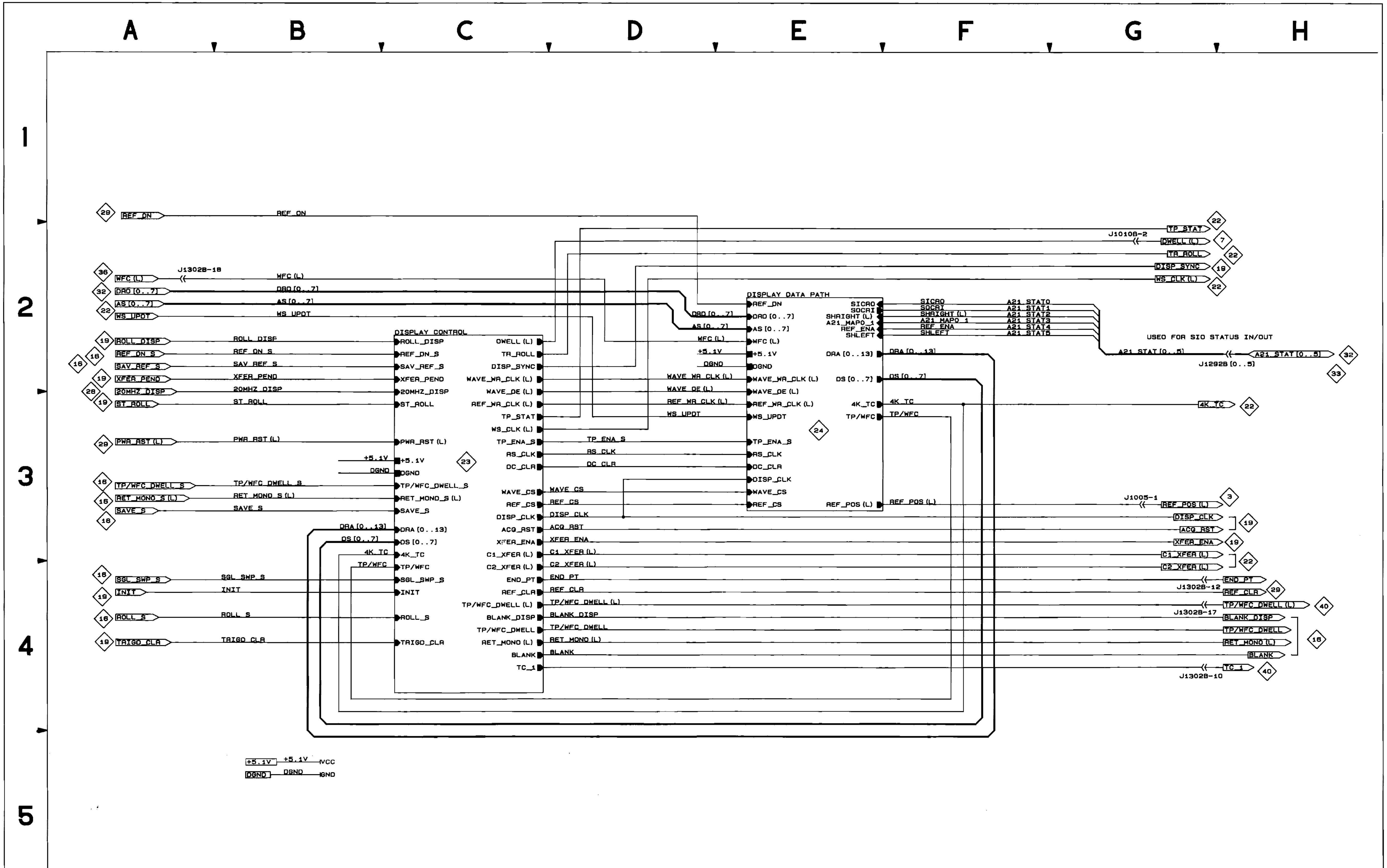
DISPLAY CONTROLLER DIAGRAM 25

Assembly A10

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C2250	3D	5E	R2261	2F	8F	U1750D	5F	7G	U2254A	4E	5E
C2251	4B	6F	R2262	3F	2F	U1764C	2F	8H	U2254B	4E	5E
						U1765B	4F	8H	U2255D	3E	7E
R1749	5G	8J	RP2200A	1F	5G	U1766C	2F	7H	U2256A	3B	6C
R2200	3D	5H	RP2200B	1E	5G	U1766D	1F	7H	U2256B	5E	6C
R2250	3C	5E	RP2200D	4C	5G	U2008	4B	6H	U2257A	3D	6E
R2251	4A	6F	RP2200E	4D	5G	U2251A	3G	6E	U2257B	4B	6E
R2252	5F	5G	RP2200F	3C	5G	U2251B	5E	6E	U2258A	3A	5E
R2253	2E	3G	RP2200G	4A	5G	U2251D	3E	6E	U2258B	4D	5E
R2254	1E	5D	RP2200H	4E	5G	U2253A	3F	6E	U2259	2E	6F
R2255	2E	5G				U2253B	4G	6E	U2261	1D	6F
R2258	3D	8C	U1502D	2G	8G	U2253C	5C	6E	U2262	2D	5F
R2259	4D	6F	U1524C	5D	5G						

Partial A10 also shown on diagrams 16, 17, 18, 19, 20, 22, 23, 24, 27, 28, 29, 30 and 31.


A B C D E F G H
1 2 3 4 5
BLOCK DECODING
DRA13 DRA12 DISPLAY DATA
0 0 WAVEFORM CHANNEL ONE
0 1 WAVEFORM CHANNEL TWO
1 0 REFERENCE CHANNEL ONE
1 1 REFERENCE CHANNEL TWO
FROM R7016 20MHZ DISP
FROM U3203B-6 PWR RST (L)
FROM U1500-6 TP/WFC DWELL S
FROM U1500-5 RET MONO S (L)
U2261
DISPLAY STATES
U2262
89EA
BLOCK STATES
FROM U1500-15 SAVE S
SAV REF S FROM U1500-19
FROM U2002/3 DS [0..7]
ROLL S FROM U1500-9
ROLL DISP FROM U1763-21
ST ROLL FROM U1754-23
FROM U2001/5/6 DRA [0..13]
U2256A 74HC139
BLOCK DECODING
FROM U1500-12 REF ON S
XFER PEND FROM U1754-17
U2258A 74HC74
TRANSFER IN PROGRESS FLAG
XFER ENA
DWELL FOR SWEEP RETRACE
U2257A
U2257B 74HC221
DWELL TO DISPLAY TRIGGER POINT OR WAVEFORM CURSOR
FROM U2001-22 4K TC
FROM U3002F-12 SGL SWP S
FROM U1753-14 INIT
TRIGD CLR FROM U1750A-3
TP/WFC FROM U2001-15
U2008 16R8L
SYNCHRONIZER AND TRIGGER POINT STATUS GENERATOR
TO U2001-23 TP ENA S
TO U1503-7 TR ROLL
TC 1
U2258B 74HC74
U2253C 74HC02
U1524C 74F00
ROLL DISP
ST ROLL
BLOCK DECODING FOR TRANSFER
NOTES:
1.) REF_DE = DRA13
2.) WAVE_CS = 0 DISABLES RAM OUTPUTS
PARTIAL A10 BOARD
U1766D 74HC02
TO U1753-5 DISP SYNC
J1302B-14 DISP SYNC TO W1302-14
RP2200B 10K SIP
R2254 10K
RP2200A 10K SIP
TO U2001-2 DC CLR
TO U1766B-5 RS CLK
TO U1520-10/12 WS CLK (L)
XFER ENA TO U1753/54-6
BLANK TO U1765C-9
U1766C 74HC02
U1502D 74HC00
BLANK DISP TO U2255C-9
R2255 10K
U1784C 74HC08
R2253 10K
R2281 10K
ACQ RST TO U1753/54-7
DISPLAY TIMING GENERATOR
U2259 CY22V10-25
TO U2005-27
WAVE WR CLK (L)
REF WR CLK (L) TO U2005-27
DISP CLK TO U2001-1/13
U1759-4
J1302B-12 END PT TO W1302B-12
END PT TO U1781/2/3-5
REFERENCE RAM CHIP SELECT DECODING
U2251D 74HC00
U2251A 74HC00
R2262 10K
TO U2005-28 REF CS NOTE 1
U2255D 74HC32
TO U1500-4 RET MONO (L)
TO U2006-26 WAVE CS NOTE 2
U2253A 74HC02
U1765B 74HC32
WAVE OE (L) TO U2006-22
WAVEFORM RAM OUTPUT ENABLE AND CHIP SELECT DECODING
REFERENCE WRITE PENDING FLAG
U2254A 74HC74
CLEAR THE SAV REF SWITCH LATCH
U2253B 74HC02
REF CLR TO U3204C-9
U2254B 74HC74
U2251B 74HC00
WAVEFORM WRITE PENDING FLAG
U1750D 74F08
R1749 10K
J1010B-2 DWELL (L) TO J1010A-2
GND TO J1010A-1
DWELL
J1302B-10 TC 1 TO J1302A-10
R2252 10K
U2256B 74HC139
C1 XFER (L) TO U1524A-1 U1506-22 U1508-1
C2 XFER (L) TO 1524B-5 U1507-22 U1501-1
TP/WFC DWELL TO U1500-7
J1302B-17 TP/WFC DWELL (L) TO J1302A-17
TP STAT TO U1503-9



DISPLAY CONTROL
DISPLAY DATA PATH
REF_ON
WFC (L)
DRO [0..7]
AS [0..7]
WS_UPDT
ROLL_DISP
REF_ON_S
SAV_REF_S
XFER_PEND
20MHZ_DISP
ST_ROLL
PWR_RST (L)
TP/WFC_DWELL_S
RET_MONO_S (L)
SAVE_S
SGL_SWP_S
INIT
ROLL_S
TRIGO_CLR
DRA [0..13]
DS [0..7]
4K_TC
TP/WFC
+5.1V
DGND
DWELL (L)
TR_ROLL
DISP_SYNC
WAVE_WR_CLK (L)
WAVE_OE (L)
REF_WR_CLK (L)
TP_STAT
WS_CLK (L)
TP_ENA_S
RS_CLK
DC_CLR
WAVE_CS
REF_CS
DISP_CLK
ACQ_RST
XFER_ENA
C1_XFER (L)
C2_XFER (L)
END_PT
REF_CLR
TP/WFC_DWELL (L)
BLANK_DISP
TP/WFC_DWELL
RET_MONO (L)
BLANK
TC_1
SICRO
SOCRI
SHRIGHT (L)
A21_MAPO_1
REF_ENA
SHLEFT
A21 STAT0
A21 STAT1
A21 STAT2
A21 STAT3
A21 STAT4
A21 STAT5
USED FOR SIO STATUS IN/OUT
A21 STAT [0..5]
J1292B [0..5]
REF_POS (L)
J1302B-18
J1010B-2
J1005-1
J1302B-12
J1302B-17
J1302B-10
VCC
GND

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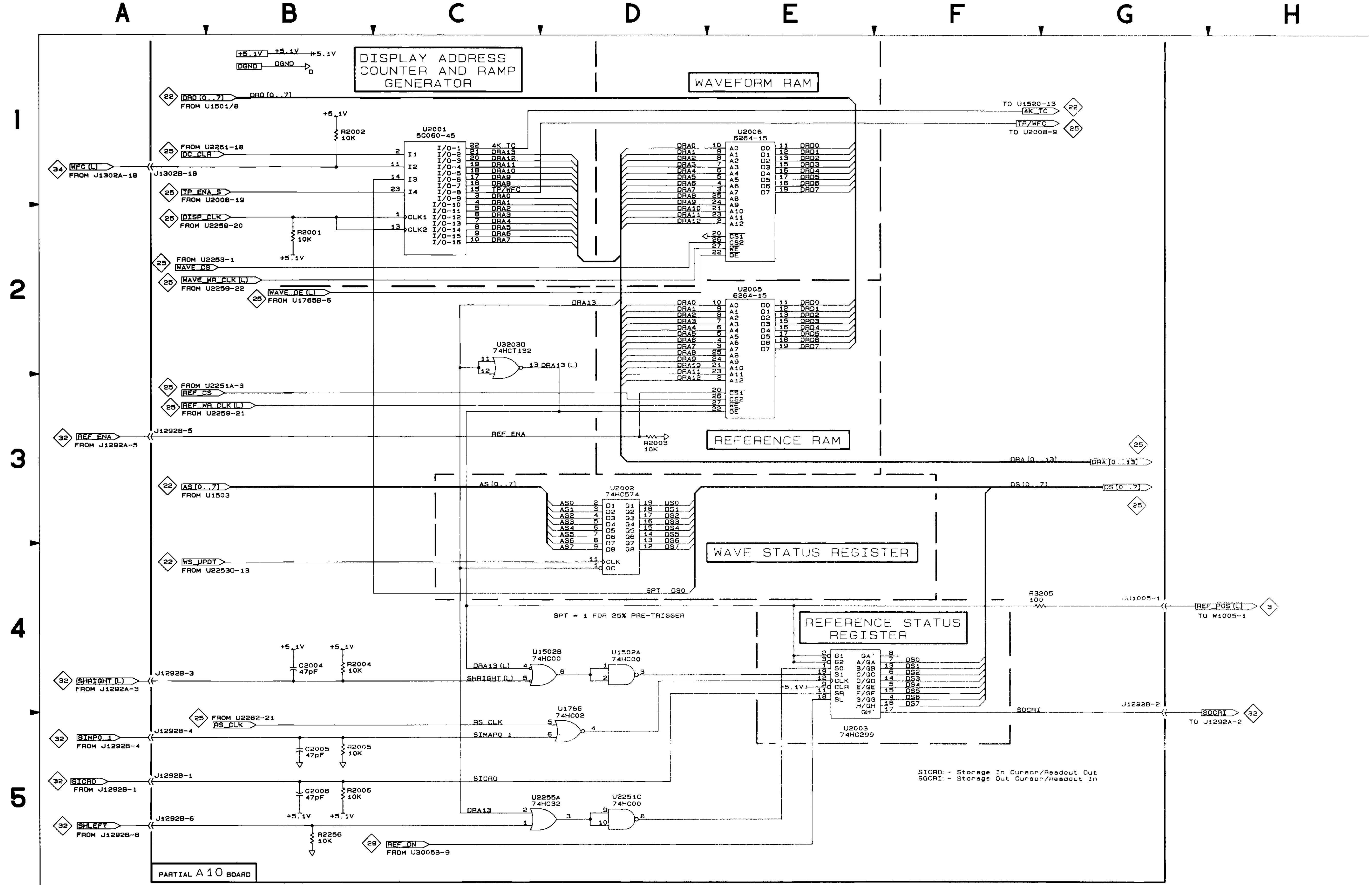
DISPLAY DATA PATH DIAGRAM 27

Assembly A10

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C2004	4B	BKBD	R2003	3D	8E	U1502A	4D	8G	U2005	2E	7C
C2005	5B	BKBD	R2004	4B	8E	U1502B	4C	8G	U2006	1E	7C
C2006	5B	BKBD	R2005	5B	8E	U1766B	5D	7H	U2251C	5D	6E
			R2006	5B	8E	U2001	1C	6D	U2255A	5C	7E
R2001	2B	6E	R2256	5B	8D	U2002	3D	7F	U3203D	2C	6H
R2002	1B	7E	R3205	4F	8H	U2003	4E	7F			

Partial A10 also shown on diagrams 16, 17, 18, 19, 20, 22, 23, 24, 25, 28, 29, 30 and 31.



2211

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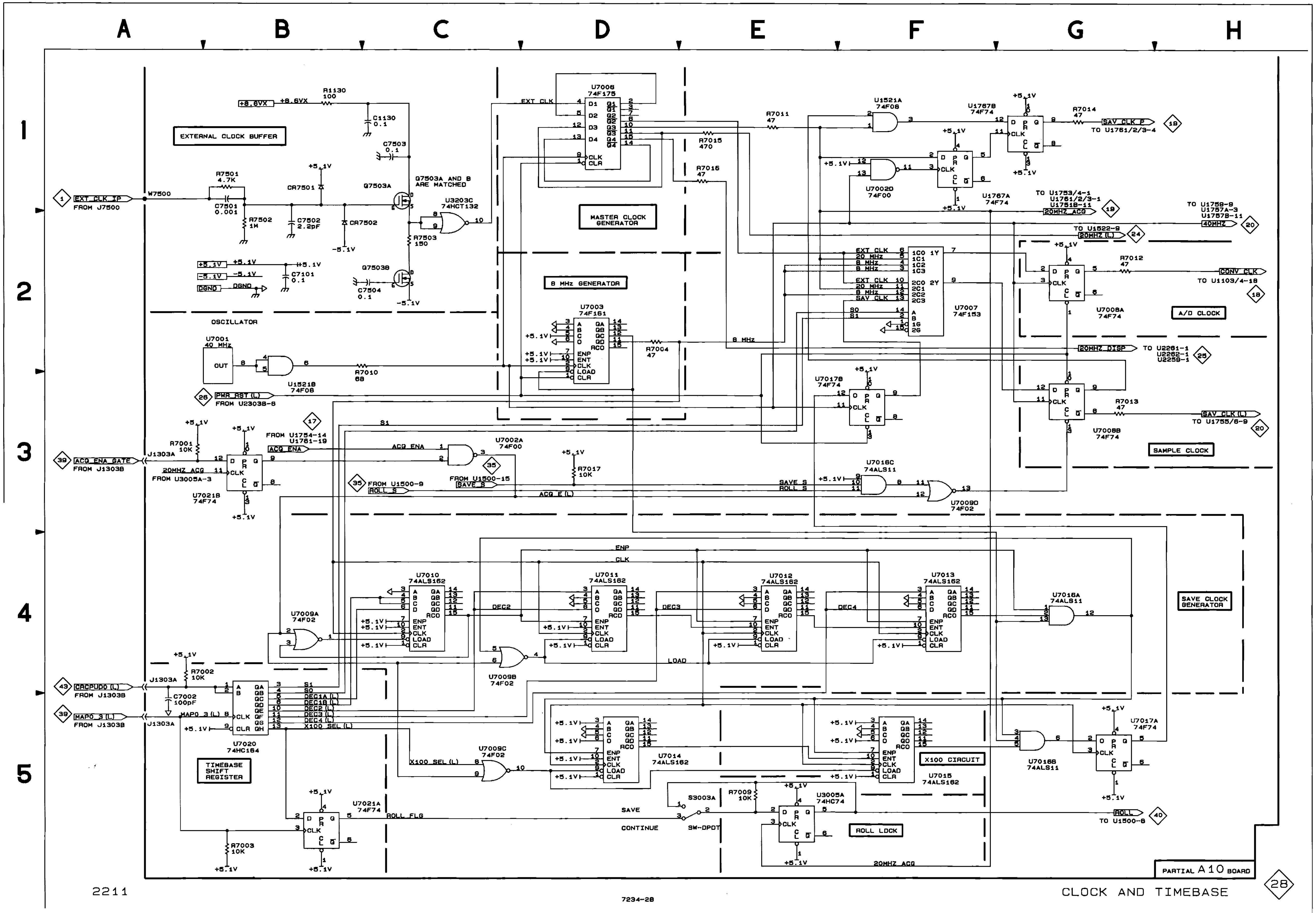
DISPLAY DATA PATH 27

CLOCK AND TIMEBASE DIAGRAM 28

Assembly A10

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1130	1C	8K	R7004	2D	4K	U1521A	1F	4K	U7009C	5C	7L
C7002	5A	5L	R7009	5E	4J	U1521B	2B	4K	U7009D	3F	7L
C7501	1B	2L	R7010	2B	4L	U1767A	1F	3J	U7010	4C	7K
C7502	2B	3L	R7011	1E	5K	U1767B	1G	3J	U7011	4D	8J
C7503	1C	3L	R7012	2G	6J	U3005A	5E	4J	U7012	4E	7J
C7504	2C	3L	R7013	3G	5J	U3203C	2C	6H	U7013	4F	7J
			R7014	1G	3J	U7001	2B	5K	U7014	5D	8K
CR7501	1B	2L	R7015	1E	5J	U7002A	3C	4K	U7015	5F	7K
CR7502	2B	2L	R7016	1E	5J	U7002D	1F	4K	U7016A	4G	6L
			R7017	3D	5H	U7003	2D	5K	U7016B	5G	6L
Q7503A	1C	3L	R7501	1B	2L	U7006	1D	5J	U7016C	3F	6L
Q7503B	2C	2L	R7502	2B	2L	U7007	2F	6K	U7017A	5G	5K
			R7503	2C	2L	U7008A	2G	6J	U7017B	3F	5K
R1130	1B	8K				U7008B	3G	6J	U7020	4B	6J
R7001	3A	5L	S3003A	5E	2K	U7009A	4B	7L	U7021A	5B	6L
R7002	4A	5L				U7009B	4C	7L	U7021B	3B	6L
R7003	5B	5L									

Partial A10 also shown on diagrams 16, 17, 18, 19, 20, 22, 23, 24, 25, 27, 29, 30 and 31.

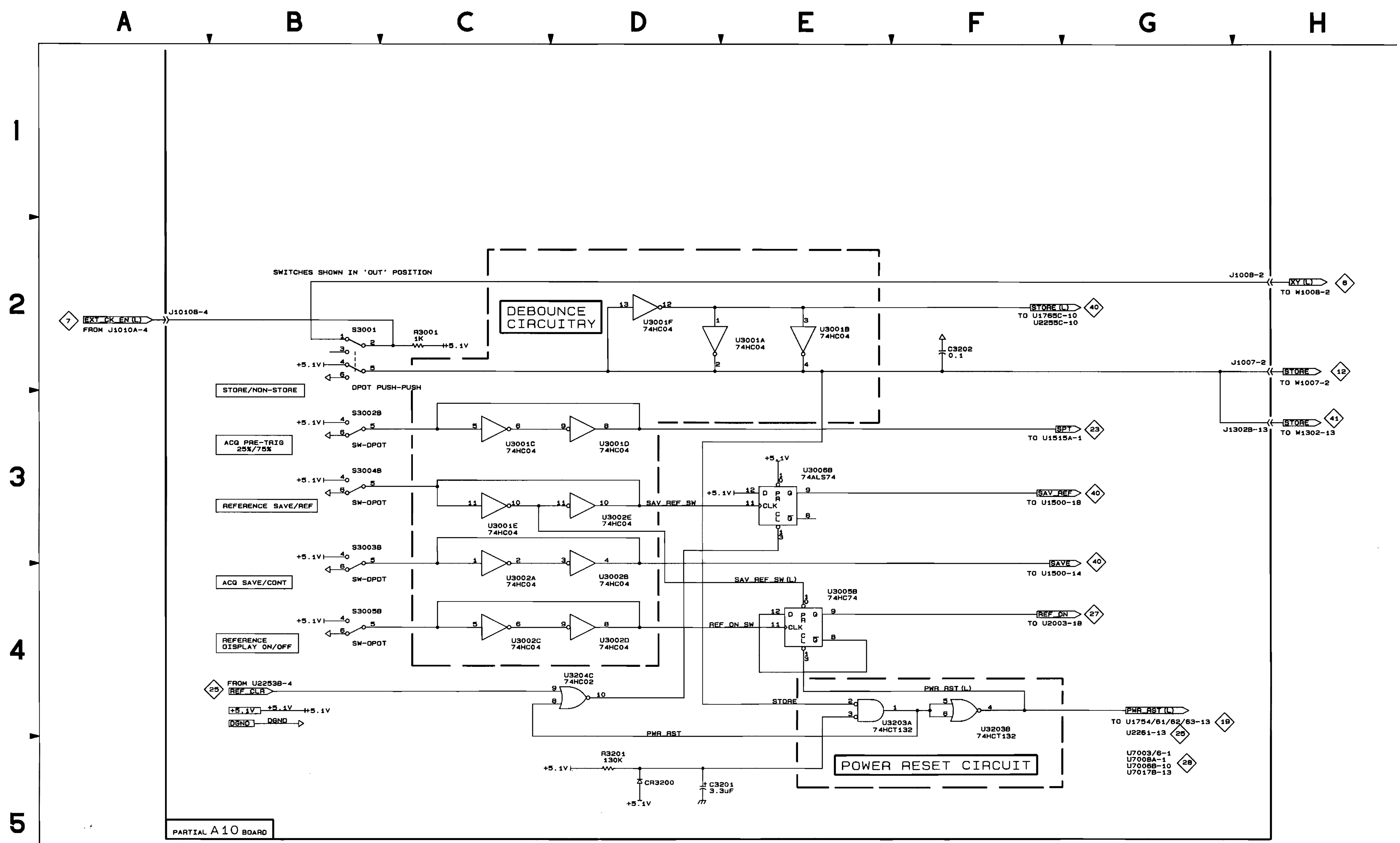

EXTERNAL CLOCK BUFFER
OSCILLATOR
MASTER CLOCK GENERATOR
8 MHz GENERATOR
A/D CLOCK
SAMPLE CLOCK
SAVE CLOCK GENERATOR
TIMEBASE SHIFT REGISTER
X100 CIRCUIT
ROLL LOCK
PARTIAL A10 BOARD
2211
7234-28
CLOCK AND TIMEBASE
28

STORAGE SWITCHES DIAGRAM 29

Assembly A10

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C3201	5D	6H	S3001	2B	2K	U3001C	3C	3K	U3002D	4D	3H
C3202	2F	8D	S3002B	3B	2K	U3001D	3D	3K	U3002E	3D	3H
			S3003B	3B	2K	U3001E	3C	3K	U3005B	4E	4J
CR3200	5D	7G	S3004B	3B	2J	U3001F	2D	3K	U3006B	3E	1F
			S3005B	4B	2J	U3002A	3C	3H	U3203A	4E	6H
R3001	2C	5L				U3002B	3D	3H	U3203B	4F	6H
R3201	5D	6H	U3001A	2D	3K	U3002C	4C	3H	U3204C	4D	8E
			U3001B	2E	3K						

Partial A10 also shown on diagrams 16, 17, 18, 19, 20, 22, 23, 24, 25, 27, 28, 30 and 31.


A
B
C
D
E
F
G
H
1
2
3
4
5
SWITCHES SHOWN IN 'OUT' POSITION
DEBOUNCE CIRCUITRY
EXT CK EN (L)
FROM J1010A-4
J1010B-4
S3001
R3001 1K
+5.1V
DPDT PUSH-PUSH
STORE/NON-STORE
U3001F 74HC04
U3001A 74HC04
U3001B 74HC04
STORE (L)
TO U1765C-10 U2255C-10
C3202 0.1
J1008-2
XY (L)
TO W1008-2
J1007-2
STORE
TO W1007-2
J1302B-13
STORE
TO W1302-13
S3002B
SW-DPDT
ACQ PRE-TRIG 25%/75%
U3001C 74HC04
U3001D 74HC04
SPT
TO U1515A-1
S3004B
REFERENCE SAVE/REF
U3001E 74HC04
U3002E 74HC04
SAV REF SW
U3006B 74ALS74
SAV REF
TO U1500-18
S3003B
ACQ SAVE/CONT
U3002A 74HC04
U3002B 74HC04
SAVE
TO U1500-14
SAV REF SW (L)
U3005B 74HC74
S3005B
REFERENCE DISPLAY ON/OFF
U3002C 74HC04
U3002D 74HC04
REF ON SW
REF ON
TO U2003-18
FROM U2253B-4
REF CLR
U3204C 74HC02
+5.1V
DGND
PWR RST (L)
STORE
U3203A 74HCT132
U3203B 74HCT132
PWR RST
PWR RST (L)
TO U1754/61/62/63-13
U2261-13
U7003/6-1
U7008A-1
U7008B-10
U7017B-13
R3201 130K
CR3200
C3201 3.3uF
POWER RESET CIRCUIT
PARTIAL A10 BOARD

A10 INTERCONNECT DIAGRAM 30

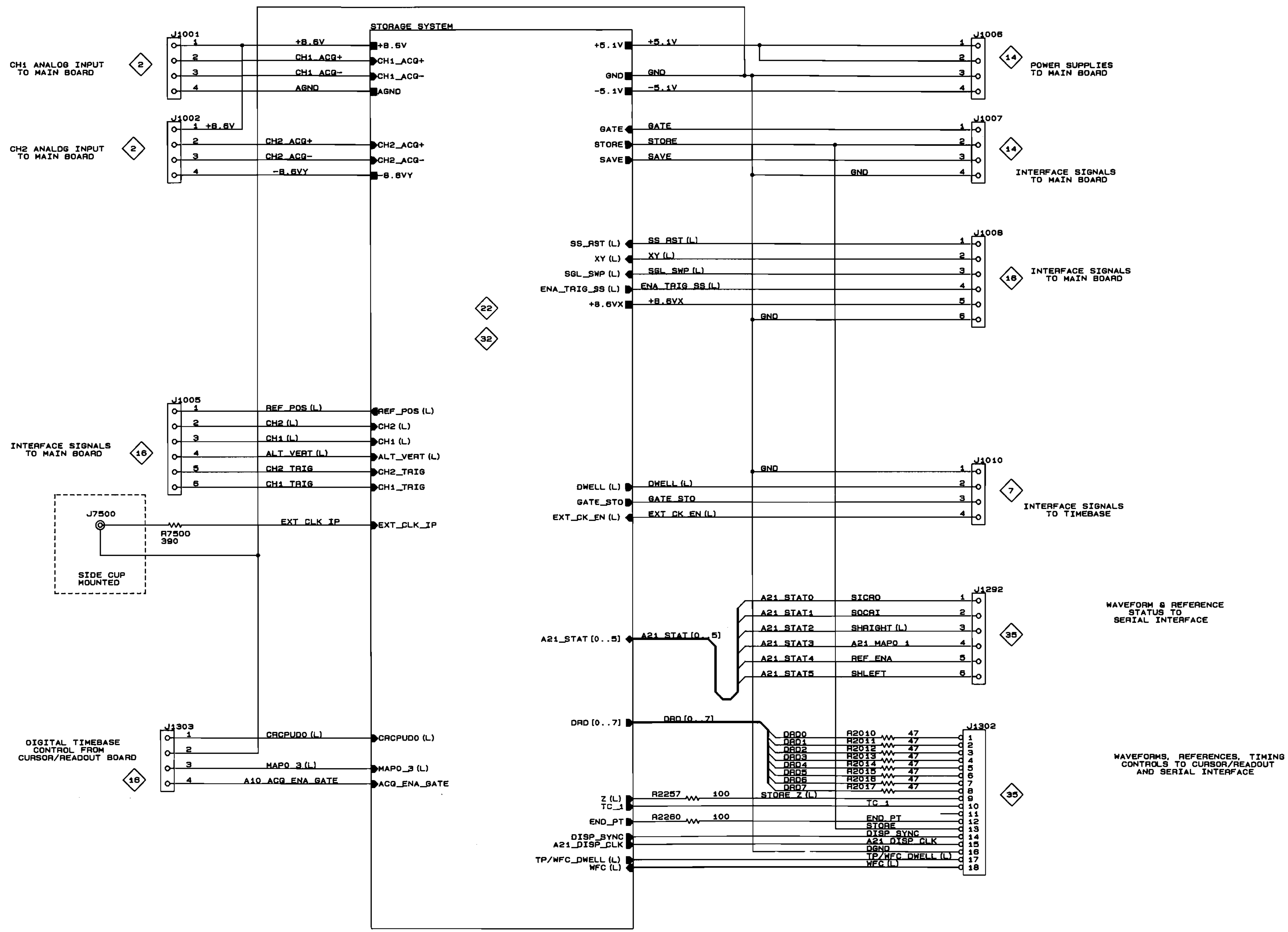
Assembly A10

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J1001	1B	6A	J1010	3F	8K	R2011	4F	8D	R2016	5F	8C
J1002	1B	8A	J1292	4F	8F	R2012	4F	8D	R2017	5F	8C
J1005	3B	8J	J1302	4F	7E	R2013	4F	8C	R2257	5E	7E
J1006	1F	8L	J1303	4B	5K	R2014	4F	8C	R2260	5E	7E
J1007	1F	8D				R2015	5F	8C	R7500	3B	2L
J1008	2F	8G	R2010	4F	8D						

Partial A10 also shown on diagrams 16, 17, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29 and 31.

OTHER PARTS

J7500	3B	CHASSIS									


STORAGE SYSTEM
J1001
CH1 ANALOG INPUT TO MAIN BOARD
+8.6V
CH1_ACQ+
CH1_ACQ-
AGND
J1002
CH2 ANALOG INPUT TO MAIN BOARD
CH2_ACQ+
CH2_ACQ-
-8.6VY
J1005
INTERFACE SIGNALS TO MAIN BOARD
REF_POS (L)
CH2 (L)
CH1 (L)
ALT_VERT (L)
CH2_TRIG
CH1_TRIG
J7500
R7500 390
EXT_CLK_IP
SIDE CLIP MOUNTED
J1303
DIGITAL TIMEBASE CONTROL FROM CURSOR/READOUT BOARD
CRCPUDO (L)
MAPO_3 (L)
A10_ACQ_ENA_GATE
ACQ_ENA_GATE
+5.1V
GND
-5.1V
J1006
POWER SUPPLIES TO MAIN BOARD
GATE
STORE
SAVE
J1007
INTERFACE SIGNALS TO MAIN BOARD
SS_RST (L)
XY (L)
SGL_SWP (L)
ENA_TRIG_SS (L)
+8.6VX
J1008
INTERFACE SIGNALS TO MAIN BOARD
DWELL (L)
GATE_STO
EXT_CK_EN (L)
J1010
INTERFACE SIGNALS TO TIMEBASE
A21_STAT [0..5]
A21_STAT0
A21_STAT1
A21_STAT2
A21_STAT3
A21_STAT4
A21_STAT5
SICRO
SOCRI
SHRIGHT (L)
A21_MAPO_1
REF_ENA
SHLEFT
J1292
WAVEFORM & REFERENCE STATUS TO SERIAL INTERFACE
DRD [0..7]
DRD0
DRD1
DRD2
DRD3
DRD4
DRD5
DRD6
DRD7
R2010
R2011
R2012
R2013
R2014
R2015
R2016
R2017
47
J1302
WAVEFORMS, REFERENCES, TIMING CONTROLS TO CURSOR/READOUT AND SERIAL INTERFACE
Z (L)
TC_1
END_PT
DISP_SYNC
A21_DISP_CLK
TP/WFC_DWELL (L)
WFC (L)
R2257 100
R2260 100
STORE_Z (L)
STORE
DGND

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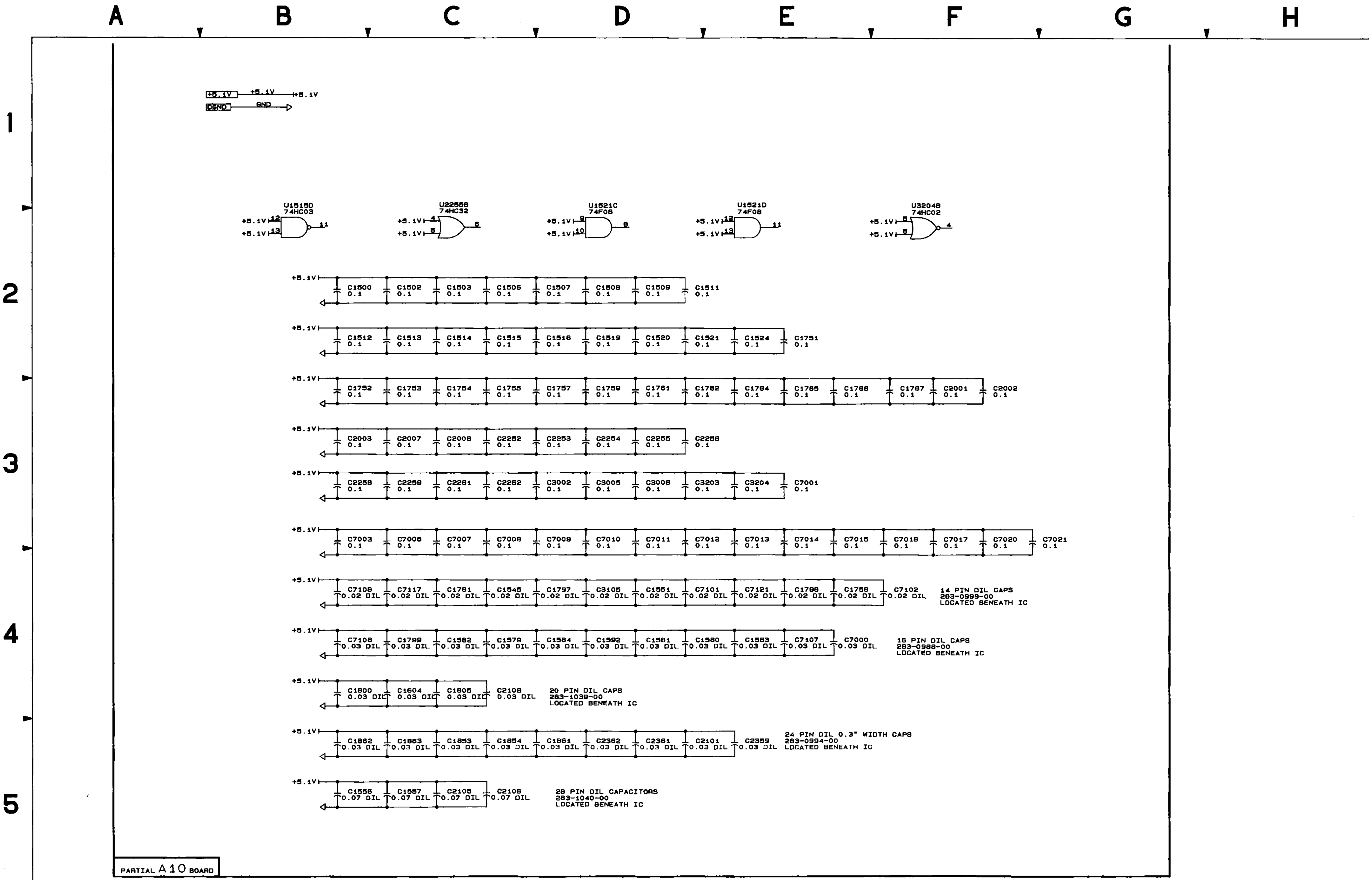
SPARE GATES & DECOUPLING CAPACITORS DIAGRAM 31

Assembly A10

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1500	2B	5G	C1600	4B	5H	C2003	3B	7F	C7006	3C	5J
C1502	2C	8G	C1604	4C	5B	C2007	3C	8C	C7007	3C	5K
C1503	2C	8F	C1605	4C	4B	C2008	3C	5H	C7008	3C	5J
C1506	2C	5C	C1751	2E	6K	C2101	5D	6D	C7009	3C	7L
C1507	2C	3D	C1752	3B	7G	C2105	5C	8C	C7010	3D	7K
C1508	2D	4C	C1753	3C	3G	C2106	5C	7C	C7011	3D	8J
C1509	2D	2F	C1754	3C	3G	C2108	4C	6H	C7012	3D	7J
C1511	2D	3F	C1755	3C	3H	C2252	3C	5E	C7013	3E	7J
C1512	2B	1E	C1756	4E	4J	C2253	3C	6E	C7014	3E	7K
C1513	2C	4E	C1757	3C	4J	C2254	3D	5E	C7015	3E	8J
C1514	2C	3F	C1759	3D	3H	C2255	3D	7E	C7016	3F	6L
C1515	2C	4E	C1761	3D	4F	C2256	3D	6C	C7017	3F	5L
C1516	2C	2F	C1762	3D	2F	C2258	3B	5E	C7020	3F	6J
C1519	2D	3D	C1764	3E	7H	C2259	3C	6G	C7021	3F	5K
C1520	2D	4H	C1765	3E	8H	C2261	3C	5F	C7101	4D	4L
C1521	2D	3L	C1766	3E	7H	C2262	3C	5F	C7102	4F	4K
C1524	2E	4G	C1767	3F	3K	C2359	5E	6G	C7106	4B	5J
C1545	4C	2E	C1781	4C	6K	C2361	5D	6G	C7107	4E	6K
C1551	4D	4L	C1796	4E	7H	C2362	5D	5G	C7108	4B	6J
C1556	5B	5C	C1797	4C	3J	C3002	3C	2H	C7117	4C	5K
C1557	5C	4C	C1799	4C	4H	C3005	3D	4K	C7121	4E	6L
C1579	4C	3E	C1853	5C	3G	C3006	3D	2H			
C1580	4D	4F	C1854	5C	3G	C3105	4D	4J			
C1581	4D	3F	C1861	5C	4G	C3203	3D	6H	U1515D	2B	2E
C1582	4C	3D	C1862	5B	2G	C3204	3E	7E	U1521C	2D	4K
C1583	4E	4F	C1863	5C	2F	C7000	4E	4K	U1521D	2E	4K
C1584	4C	3F	C2001	3F	6C	C7001	3E	4L	U2255B	2C	7E
C1592	4D	2H	C2002	3F	7F	C7003	3B	3J	U3204B	2F	8E

Partial A10 also shown on diagrams 16, 17, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29 and 30.



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SPARE GATES & DECOUPLING CAPACITORS 31

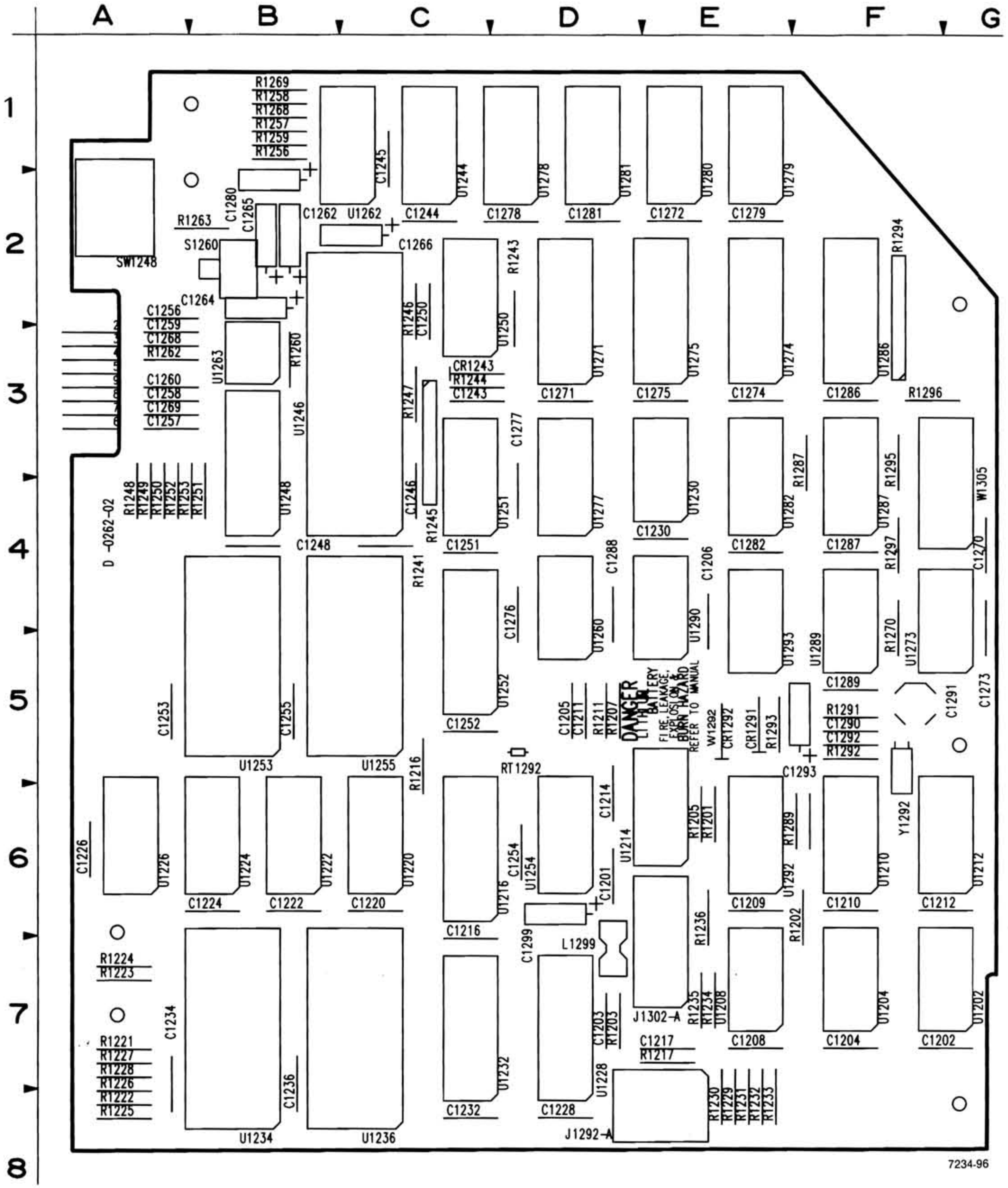


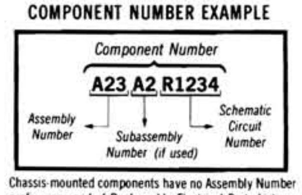
Figure 9-13. A21—Serial Interface board.

A21—SERIAL INTERFACE BOARD

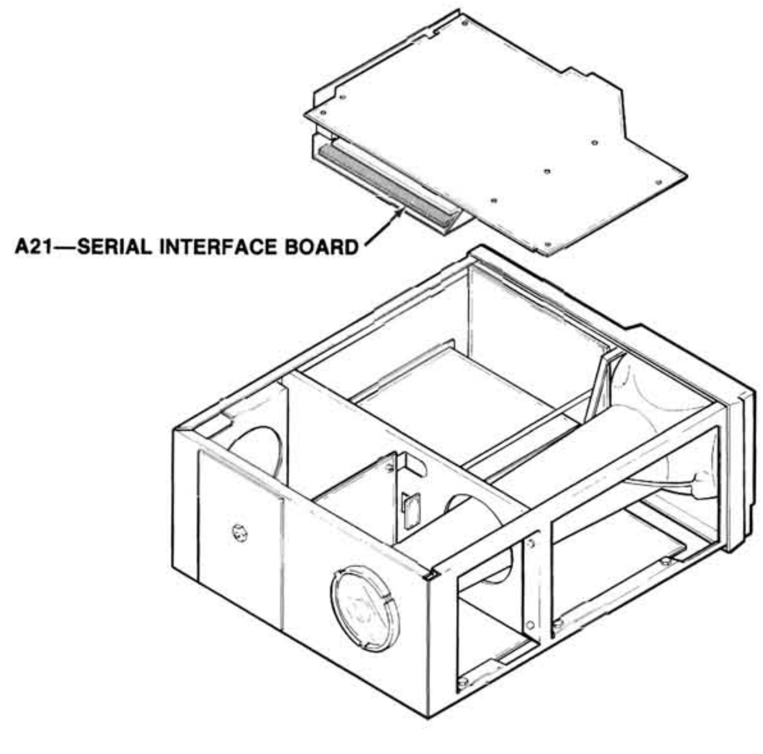
CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
C1201	35	C1254	34	C1299	35	R1234	32	R1295	38	U1252	33
C1202	34	C1255	34			R1235	32	R1296	38	U1253	33
C1203	35	C1256	34	CR1243	33	R1236	32	R1297	38	U1254	33
C1204	34	C1257	34			R1241	33			U1255	33
C1205	32	C1258	34	J1292	35	R1243	33	S1248	33	U1260	32
C1206	34	C1259	34	J1302	35	R1244	33	S1260	34	U1260	34
C1208	34	C1260	34	J1305	35	R1245	33			U1260	38
C1209	34	C1262	34			R1246	33	U1202	32	U1262	34
C1210	34	C1264	34			R1247	33	U1204	32	U1263	34
C1211	32	C1265	34	L1299	35	R1248	33	U1208	32	U1271	36
C1212	34	C1266	34			R1249	33	U1208	33	U1273	32
C1214	34	C1268	34	R1201	32	R1250	33	U1210	32	U1273	33
C1216	34	C1269	34	R1202	32	R1251	33	U1212	32	U1273	36
C1217	32	C1270	36	R1203	33	R1252	33	U1214	32	U1273	38
C1220	34	C1271	34	R1205	32	R1253	33	U1216	32	U1274	36
C1222	34	C1272	34	R1207	32	R1256	34	U1220	32	U1275	36
C1224	34	C1273	34	R1211	32	R1257	34	U1222	32	U1277	36
C1226	34	C1274	34	R1216	32	R1258	34	U1224	32	U1278	36
C1228	34	C1275	34	R1217	32	R1259	34	U1226	32	U1279	36
C1230	34	C1276	34	R1221	32	R1260	34	U1228	32	U1280	36
C1232	34	C1277	34	R1222	32	R1262	34	U1230	32	U1281	36
C1234	34	C1278	34	R1223	32	R1263	34	U1230	33	U1282	36
C1236	34	C1279	34	R1224	32	R1268	34	U1230	38	U1286	38
C1243	33	C1280	34	R1225	32	R1269	34	U1232	32	U1287	38
C1244	34	C1281	34	R1226	32	R1270	36	U1234	32	U1289	38
C1245	34	C1282	34	R1227	32	R1287	38	U1236	32	U1290	38
C1246	34	C1286	34	R1228	32	R1289	38	U1244	33	U1292	38
C1248	34	C1287	34	R1229	32	R1291	38	U1246	33	U1293	36
C1250	34	C1288	34	R1230	32	R1292	38	U1248	33	U1293	38
C1251	34	C1289	34	R1231	32	R1293	38	U1250	33		
C1252	34	C1290	38	R1232	32	R1294	38	U1251	33	Y1292	38
C1253	34	C1293	38	R1233	32						

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

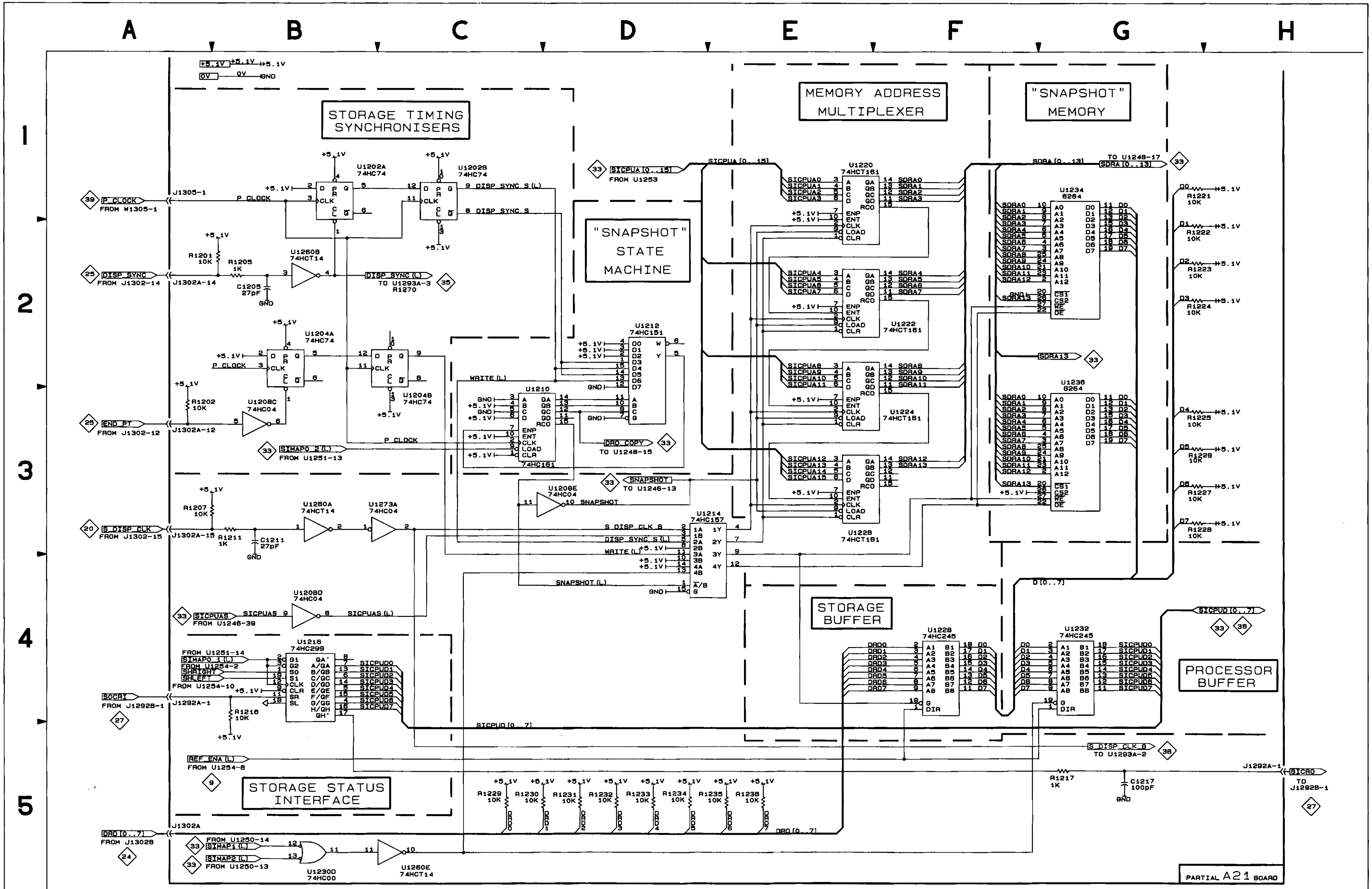


HOST INTERFACE DIAGRAM 32

Assembly A21

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1205	2B	5D	R1223	2G	7A	R1236	5E	6E	U1220	1E	6C
C1211	3B	5D	R1224	2G	7A				U1222	2E	6B
C1217	5G	7E	R1225	3G	8A	U1202A	1B	7G	U1224	2E	6B
			R1226	3G	7A	U1202B	1C	7G	U1226	3E	6A
R1201	2B	6E	R1227	3G	7A	U1204A	2B	7F	U1228	4F	7D
R1202	3A	6F	R1228	3G	7A	U1204B	2B	7F	U1230D	5B	4E
R1205	2B	6E	R1229	5C	8E	U1208C	3B	7E	U1232	4G	7D
R1207	3A	5D	R1230	5C	8E	U1208D	4B	7E	U1234	1G	8B
R1211	3B	5D	R1231	5D	8E	U1208E	3C	7E	U1236	3G	8C
R1216	4B	5C	R1232	5D	8E	U1210	3C	6F	U1260A	3B	5D
R1217	5G	7E	R1233	5D	8E	U1212	2D	6G	U1260B	2B	5D
R1221	1G	7A	R1234	5D	7E	U1214	3D	6D	U1260E	5C	5D
R1222	2G	8A	R1235	5E	7E	U1216	4B	6D	U1273A	3B	5F

Partial A21 also shown on diagrams 33, 34, 35, 36 and 38.



2211

HOST INTERFACE 32

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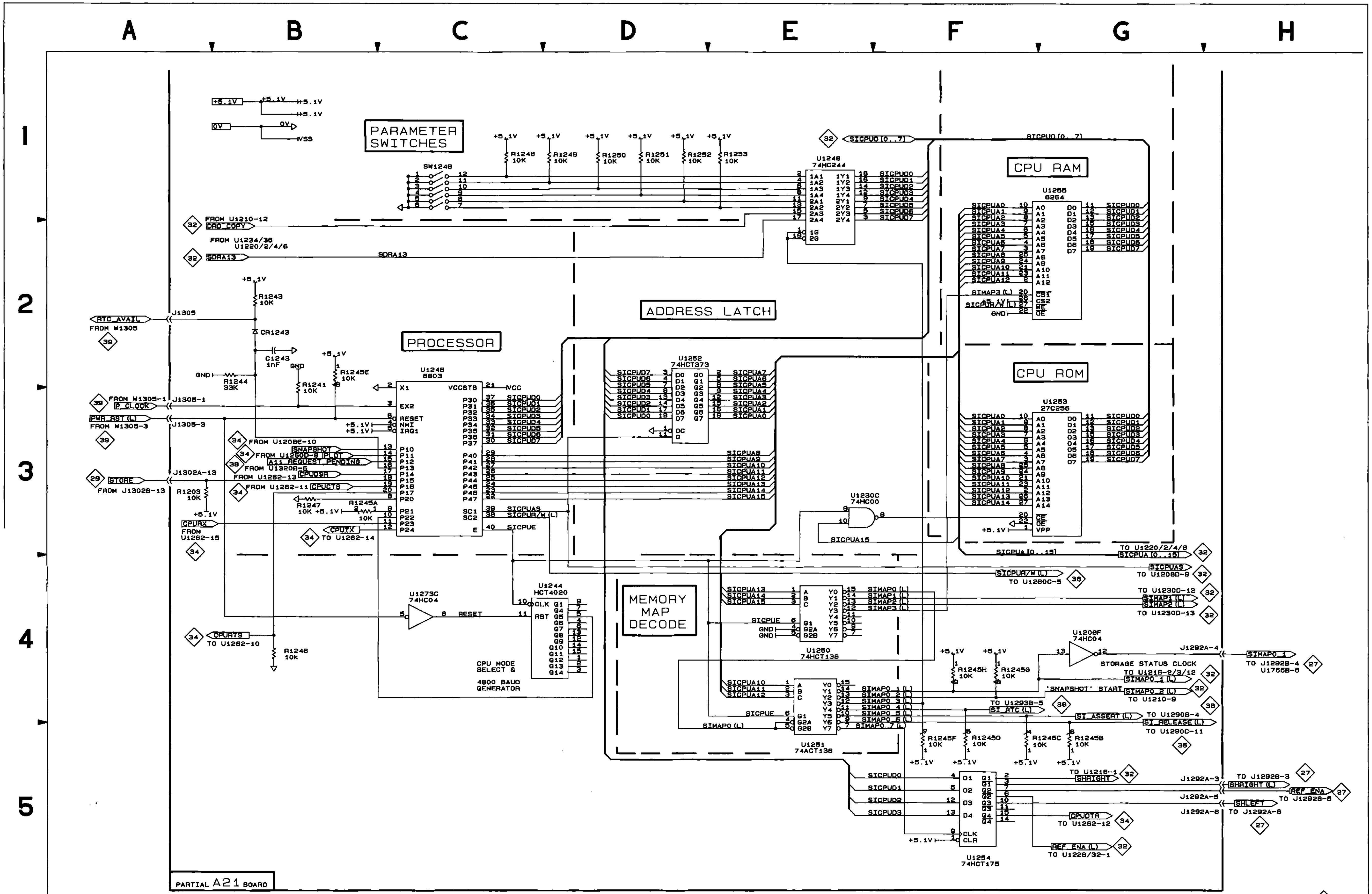
PROCESSOR AND MEMORY DIAGRAM 33

Assembly A21

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1243	2B	3C	R1245C	5F	4C	R1250	1D	4A	U1246	2C	3B
			R1245D	5F	4C	R1251	1D	4B	U1248	1E	4B
CR1243	2B	3C	R1245E	2B	4C	R1252	1D	4A	U1250	4E	3D
			R1245F	5F	4C	R1253	1E	4A	U1251	4E	4D
R1203	3A	7D	R1245G	4F	4C				U1252	2D	5D
R1241	2B	4C	R1245H	4F	4C	S1248	1C	2A	U1253	3F	5B
R1243	2B	2D	R1246	4B	2C				U1254	5F	6D
R1244	2B	3C	R1247	3B	3C	U1208F	4G	7E	U1255	1F	5C
R1245A	3B	4C	R1248	1C	4A	U1230C	3E	4E	U1273C	4C	5F
R1245B	5G	4C	R1249	1D	4A	U1244	4C	2C			

Partial A21 also shown on diagrams 32, 34, 35, 36 and 38.


PARAMETER SWITCHES
CPU RAM
ADDRESS LATCH
PROCESSOR
CPU ROM
MEMORY MAP DECODE
CPU MODE SELECT & 4800 BAUD GENERATOR
STORAGE STATUS CLOCK
PARTIAL A21 BOARD

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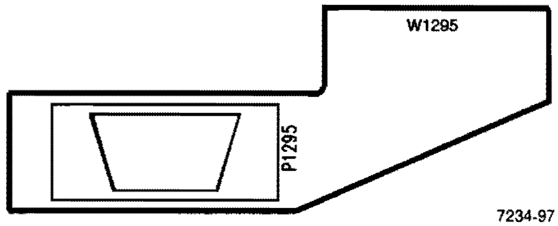
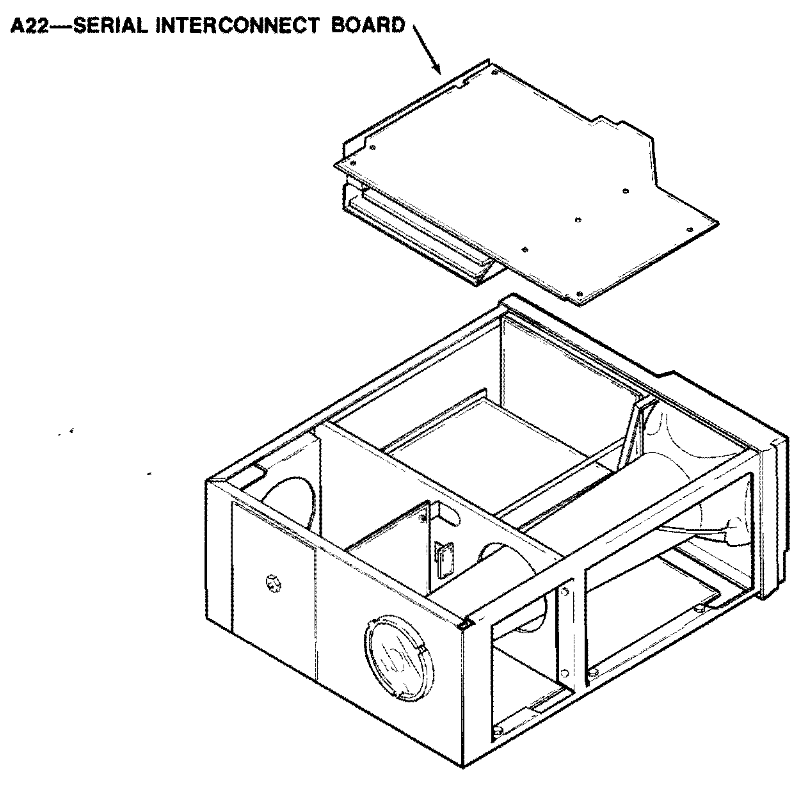


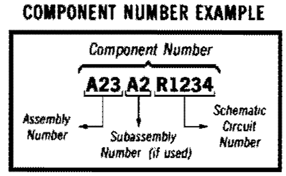
Figure 9-14. A22—Serial Interconnect board.

A22—SERIAL INTERCONNECT BOARD											
CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
P1295	35	W1295	35								



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



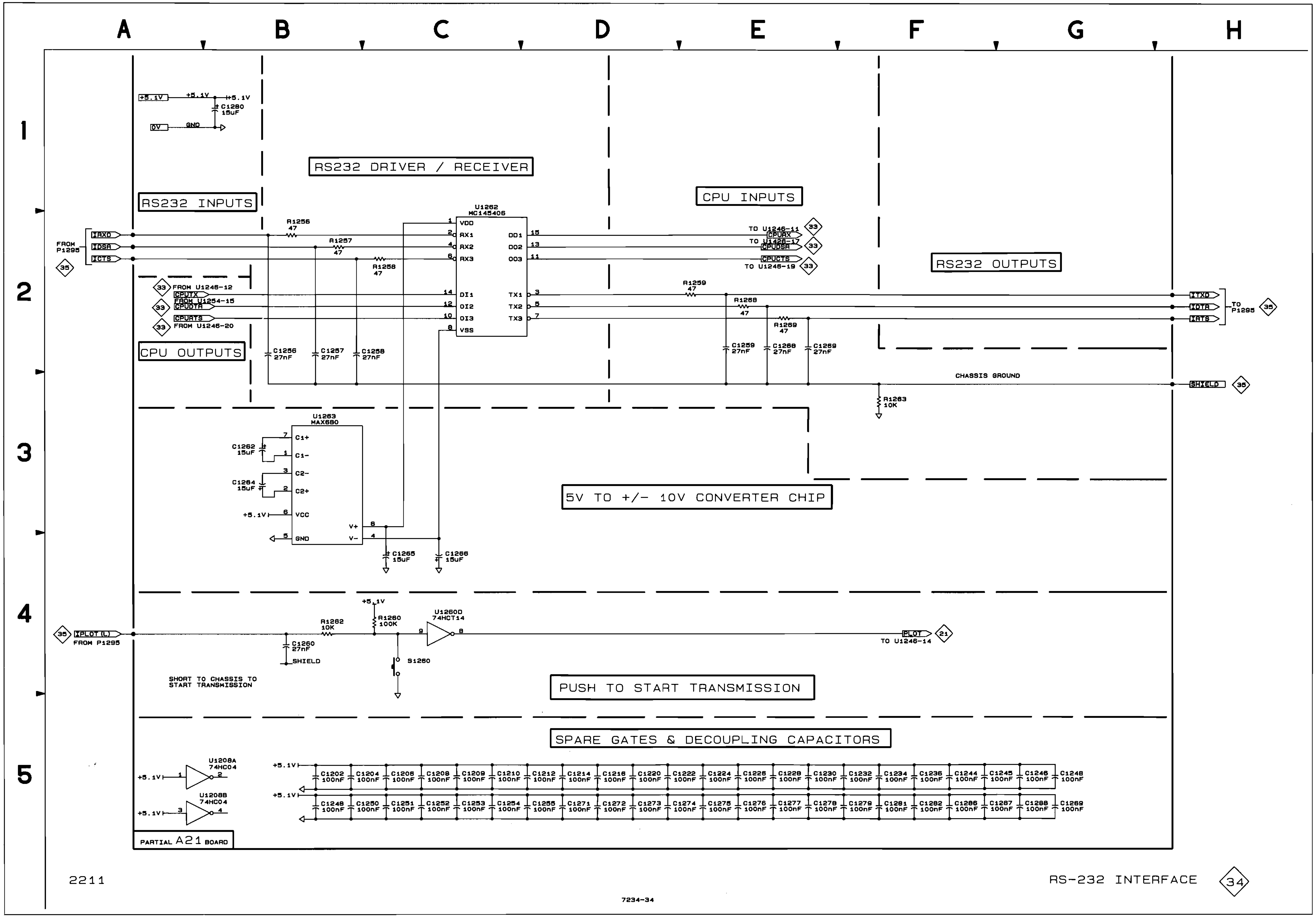
Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

RS-232 INTERFACE DIAGRAM 34

Assembly A21

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1202	5B	7F	C1244	5F	2C	C1266	4C	2C	C1289	5G	5F
C1204	5B	7F	C1245	5F	1C	C1268	2E	3A	R1256	2B	1B
C1206	5C	4E	C1246	5G	4C	C1269	2E	3A	R1257	2B	1B
C1208	5C	7E	C1248	5G	4B	C1271	5D	3D	R1258	2C	1B
C1209	5C	6E	C1250	5B	2C	C1272	5D	2E	R1259	2E	1B
C1210	5C	6F	C1251	5C	4C	C1273	5D	5G	R1260	4C	3B
C1212	5D	6F	C1252	5C	5C	C1274	5D	3E	R1262	4B	3A
C1214	5D	6D	C1253	5C	5A	C1275	5E	3E	R1263	3F	2B
C1216	5D	6C	C1254	5C	6D	C1276	5E	4D	R1268	2E	1B
C1220	5D	6C	C1255	5D	5B	C1277	5E	3D	R1269	2E	1B
C1222	5D	6B	C1256	2B	2A	C1278	5E	2D			
C1224	5E	6B	C1257	2B	3A	C1279	5F	2E	S1260	4C	2B
C1226	5E	6A	C1258	2B	3A	C1280	1B	2B			
C1228	5E	8D	C1259	2E	2A	C1281	5F	2D	U1208A	5A	7E
C1230	5E	4E	C1260	4B	3A	C1282	5F	4E	U1208B	5A	7E
C1232	5F	8C	C1262	3B	2B	C1286	5F	3F	U1260D	4C	5D
C1234	5F	7A	C1264	3B	2B	C1287	5F	4F	U1262	2C	2C
C1236	5F	8B	C1265	4C	2B	C1288	5G	4D	U1263	3B	3B

Partial A21 also shown on diagrams 32, 33, 35, 36 and 38.

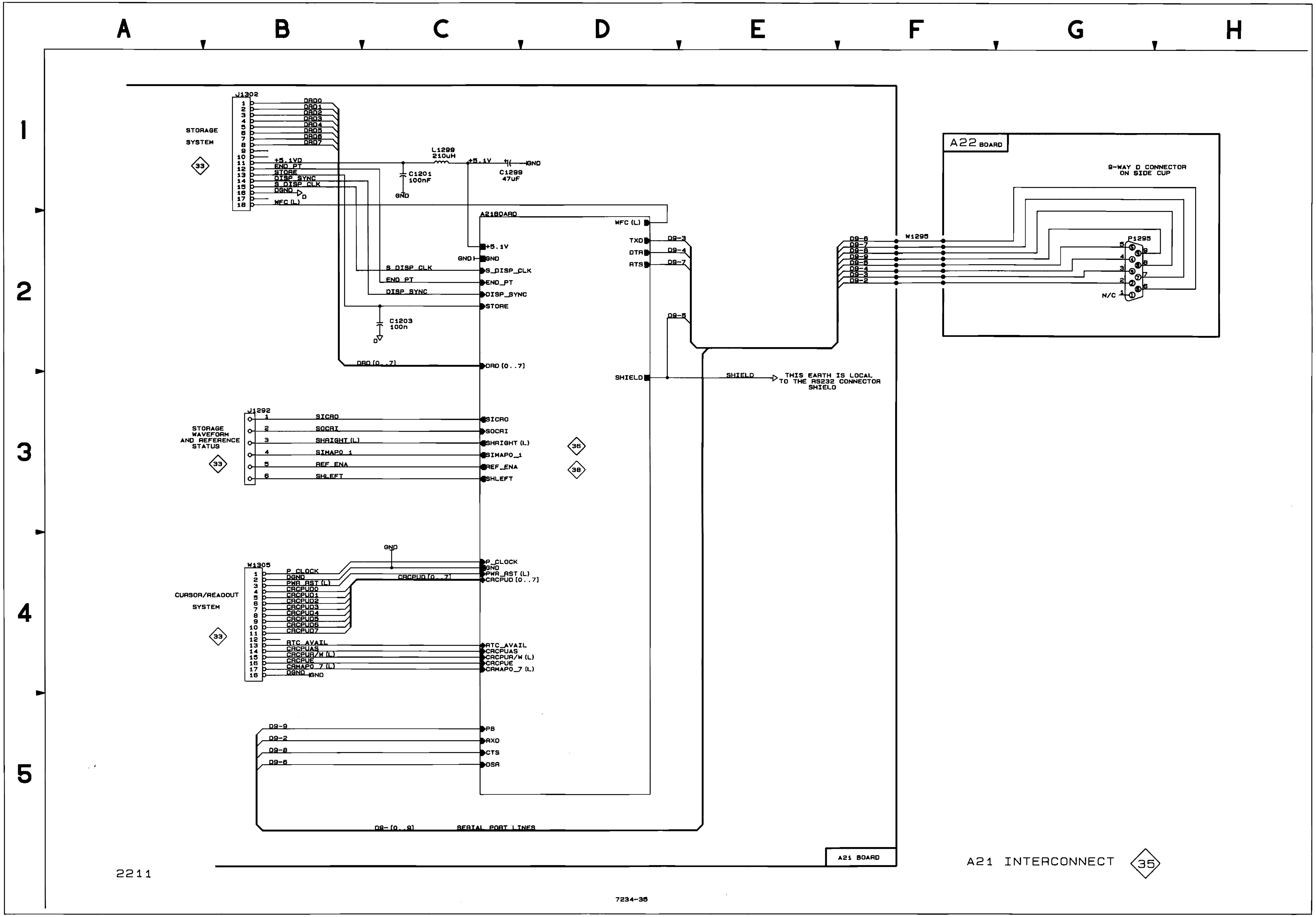

RS232 DRIVER / RECEIVER
RS232 INPUTS
CPU INPUTS
RS232 OUTPUTS
CPU OUTPUTS
5V TO +/- 10V CONVERTER CHIP
PUSH TO START TRANSMISSION
SPARE GATES & DECOUPLING CAPACITORS
U1262 MC145406
U1263 MAX680
CHASSIS GROUND
SHORT TO CHASSIS TO START TRANSMISSION
PARTIAL A21 BOARD

A21 INTERCONNECT DIAGRAM 35

Assembly A21											
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1201	1C	6D	C1299	1C	7D	J1302	1B	7E	L1299	1C	7D
C1203	2C	7D	J1292	3B	8D	J1305	4B	4G			

Partial A21 also shown on diagrams 32, 33, 34, 36 and 38.

Assembly A22											
P1295	1A	1A	W1295	1A	1A						



2211

A21 INTERCONNECT 35

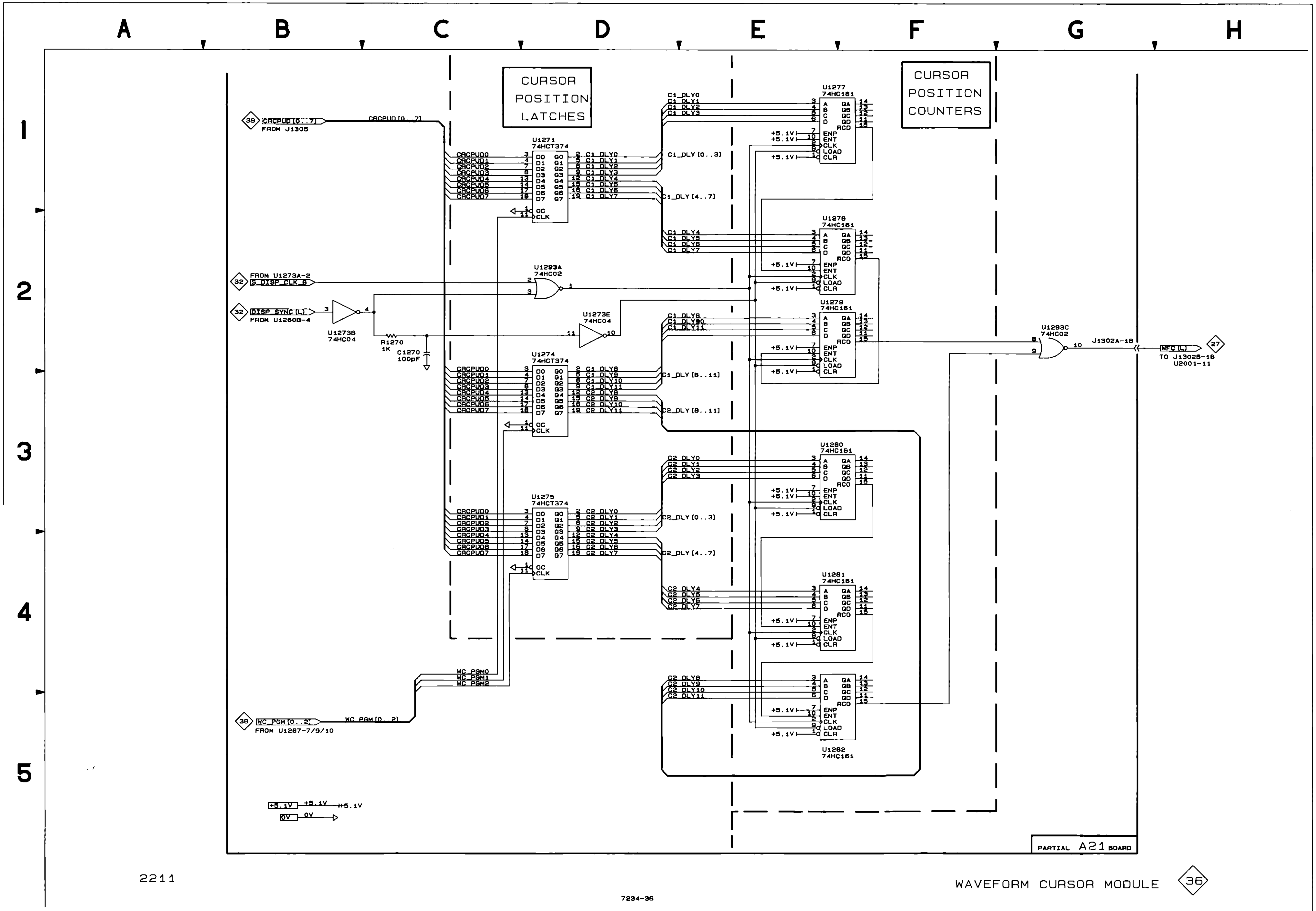
7234-38

WAVEFORM CURSOR MODULE DIAGRAM 36

Assembly A21

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1270	2C	4G	U1273B	2B	5F	U1277	1E	4D	U1281	4E	2D
			U1273E	2D	5F	U1278	2E	2D	U1282	4E	4E
R1270	2C	5F	U1274	2D	3E	U1279	2E	2E	U1293A	2D	5E
			U1275	3D	3E	U1280	3E	2E	U1293C	2G	5E
U1271	1D	3D									

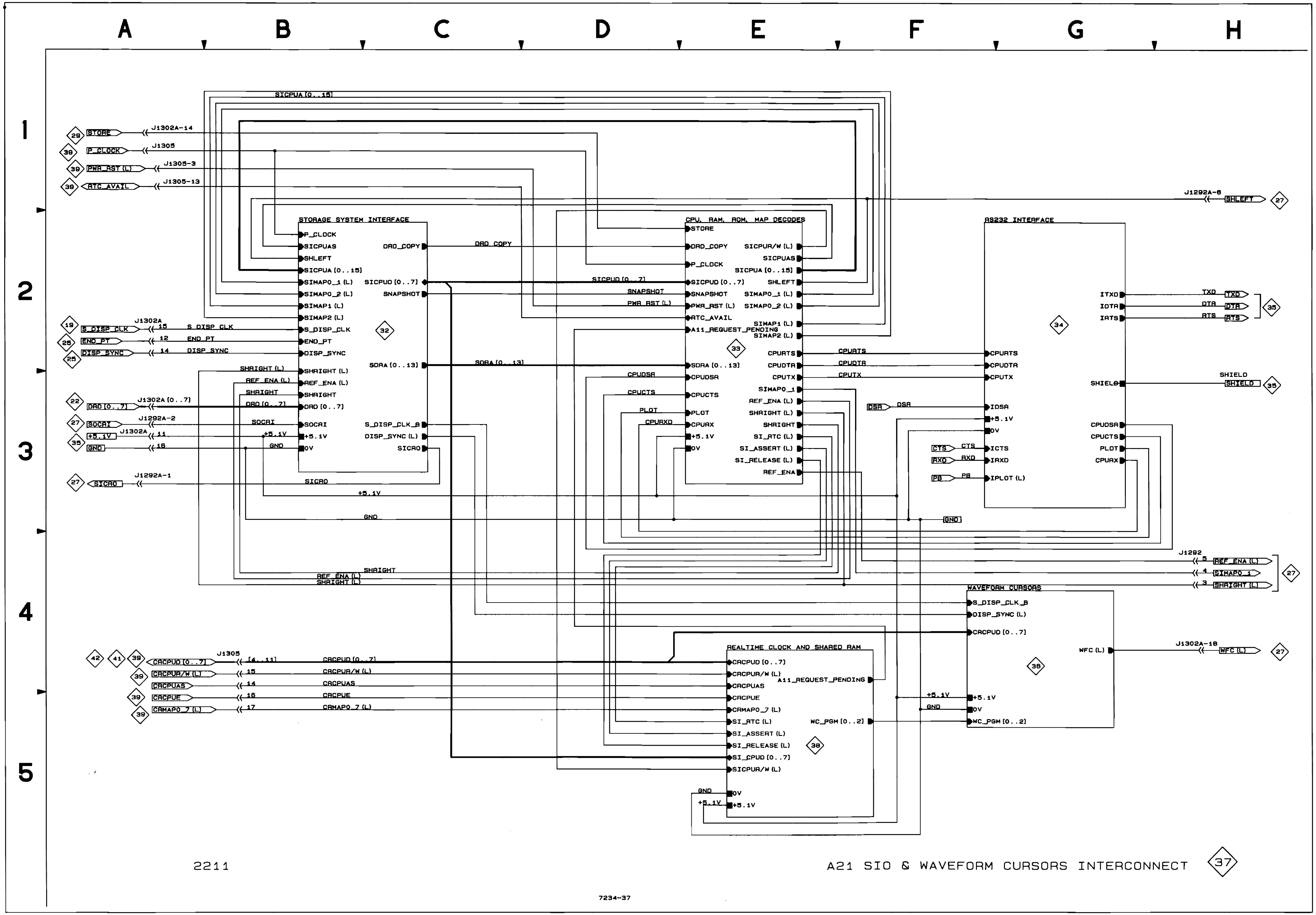
Partial A21 also shown on diagrams 32, 33, 34, 35 and 38.



2211

WAVEFORM CURSOR MODULE 36

7234-36



2211

A21 SIO & WAVEFORM CURSORS INTERCONNECT 37

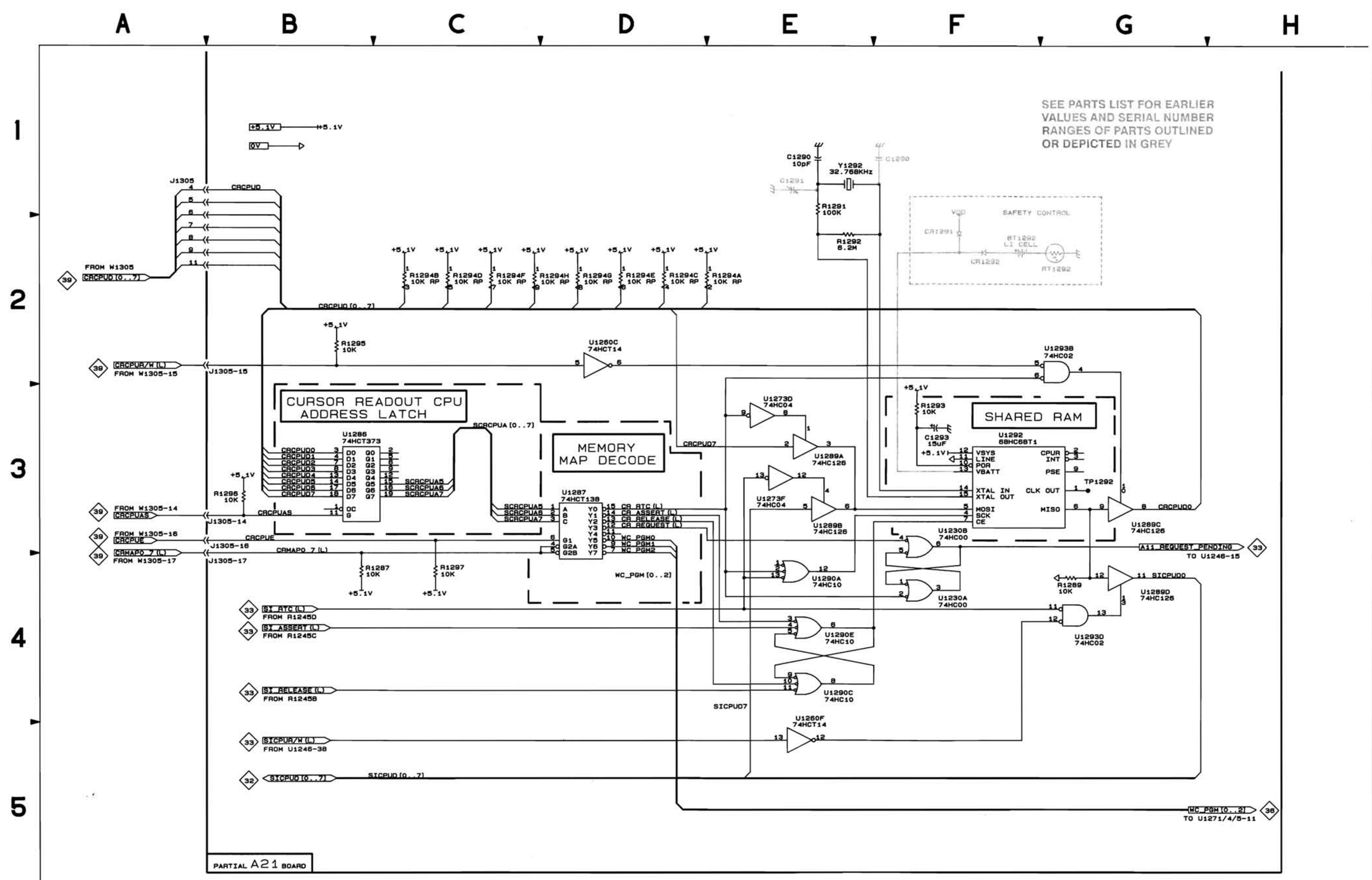
7234-37

SHARED RAM DIAGRAM 38

Assembly A21

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1290	1E	5F	R1294C	2D	2F	U1230A	4F	4E	U1289C	3G	5F
C1293	2F	5F	R1294D	2C	2F	U1230B	3F	4E	U1289D	4G	5F
			R1294E	2D	2F	U1260C	2D	5D	U1290A	4E	4E
R1287	4B	3F	R1294F	2C	2F	U1260F	5E	5D	U1290B	4E	4E
R1289	4G	6E	R1294G	2D	2F	U1273D	3E	5F	U1290C	4E	4E
R1291	1E	5F	R1294H	2C	2F	U1273F	3E	5F	U1292	3F	6E
R1292	2E	5F	R1295	2B	3F	U1286	3B	3F	U1293B	2G	5E
R1293	2F	5E	R1296	3B	3F	U1287	3D	4F	U1293D	4G	5E
R1294A	2D	2F	R1297	4C	4F	U1289A	3E	5F			
R1294B	2C	2F				U1289B	3E	5F	Y1292	1E	6F

Partial A21 also shown on diagrams 32, 33, 34, 35 and 36.



A B C D E F G H
1 2 3 4 5
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY
CURSOR READOUT CPU ADDRESS LATCH
MEMORY MAP DECODE
SHARED RAM
SAFETY CONTROL
U1286 74HCT373
U1287 74HCT138
U1292 68HC68T1
Y1292 32.768KHz
C1290 10pF
R1291 100K
R1292 8.2M
R1293 10K
C1293 15uF
BT1292 LI CELL
U1260C 74HCT14
U1260F 74HCT14
U1293B 74HC02
U1293D 74HC02
U1273D 74HC04
U1273F 74HC04
U1289A 74HC126
U1289B 74HC126
U1289C 74HC126
U1289D 74HC126
U1290A 74HC10
U1290E 74HC10
U1290C 74HC10
U1230B 74HC00
U1230A 74HC00
J1305
FROM W1305 CRCPUD[0..7]
CRCPUR/W(L) FROM W1305-15
FROM W1305-14 CRCPUAS
FROM W1305-16 CRCPUE
CRMAPO_7(L) FROM W1305-17
SI_RTC(L) FROM R1245D
SI_ASSERT(L) FROM R1245C
SI_RELEASE(L) FROM R1245B
SICPUR/W(L) FROM U1246-38
SICPUD[0..7]
A11_REQUEST_PENDING TO U1246-15
WC_PGM[0..2] TO U1271/4/5-11
CR_RTC(L)
CR_ASSERT(L)
CR_RELEASE(L)
CR_REQUEST(L)
TP1292
PARTIAL A21 BOARD

2211

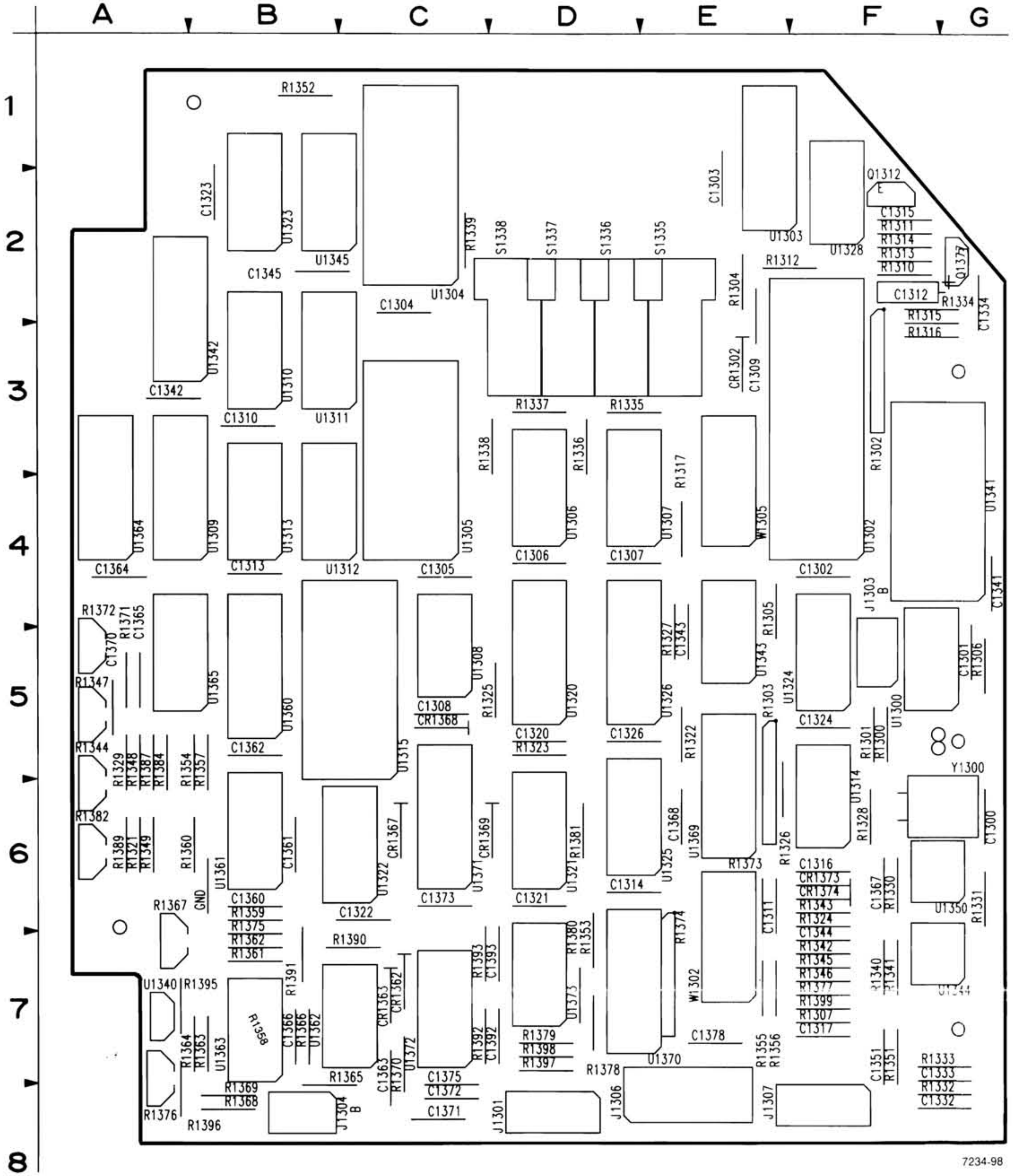
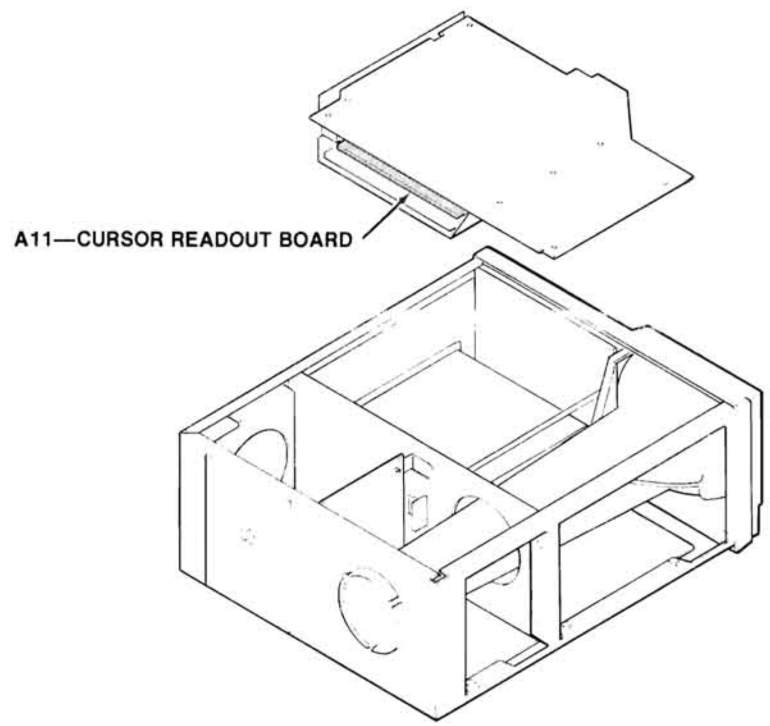


Figure 9-15. A11—Cursor Readout board.

A11—CURSOR READOUT BOARD

CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
C1300	39	C1364	44	R1303	39	R1342	41	R1379	42	U1314	39
C1301	39	C1365	44	R1303	40	R1343	41	R1380	42	U1315	39
C1302	44	C1366	42	R1304	39	R1344	41	R1381	40	U1320	40
C1303	44	C1367	44	R1305	43	R1345	41	R1382	42	U1321	40
C1304	44	C1368	44	R1306	39	R1346	41	R1384	42	U1322	40
C1305	44	C1370	42	R1307	41	R1347	41	R1387	42	U1323	40
C1306	44	C1371	42	R1307	44	R1348	41	R1389	42	U1324	40
C1307	44	C1372	42	R1310	39	R1349	41	R1390	42	U1325	40
C1308	44	C1373	44	R1311	39	R1351	41	R1391	42	U1326	40
C1309	39	C1375	42	R1312	39	R1352	41	R1393	42	U1328	39
C1310	44	C1378	44	R1313	39	R1353	39	R1395	42	U1328	44
C1311	42			R1314	39	R1354	42	R1396	42	U1340	41
C1312	39			R1315	39	R1355	40	R1397	42	U1341	41
C1313	44	CR1302	39	R1316	39	R1356	39	R1398	42	U1342	41
C1314	44	CR1362	42	R1317	39	R1357	42	R1399	42	U1343	40
C1315	39	CR1363	42	R1321	41	R1358	42			U1343	41
C1316	44	CR1367	40	R1322	40	R1359	42	S1335	41	U1343	43
C1317	41	CR1368	40	R1323	40	R1360	42	S1336	41	U1344	41
C1320	44	CR1369	40	R1324	40	R1361	42	S1337	41	U1345	41
C1321	44	CR1373	42	R1325	40	R1362	42	S1338	41	U1350	41
C1322	44	CR1374	42	R1326	40	R1363	42			U1360	42
C1323	44			R1327	40	R1364	42	U1300	39	U1361	42
C1324	44	J1301	44	R1328	42	R1365	42	U1300	42	U1362	42
C1326	44	J1303	44	R1329	41	R1366	42	U1302	39	U1363	42
C1332	41	J1304	44	R1330	41	R1367	42	U1303	39	U1364	42
C1333	41	J1304A	8	R1331	41	R1368	42	U1304	39	U1365	42
C1334	41	J1304B	42	R1332	41	R1369	42	U1305	39	U1369	40
C1341	41	J1305	38	R1333	41	R1370	42	U1306	39	U1370	42
C1342	44	J1306	44	R1334	41	R1371	42	U1307	39	U1371	42
C1343	44	J1307	44	R1335	41	R1372	42	U1308	39	U1372	42
C1344	41			R1336	41	R1373	42	U1308	40	U1373	42
C1345	44	Q1377	39	R1337	41	R1374	42	U1309	39		
C1351	41			R1338	41	R1375	42	U1310	39	W1302	44
C1360	42	R1300	39	R1339	41	R1376	42	U1311	39	W1305	39
C1361	42	R1301	39	R1340	41	R1377	42	U1312	39		
C1362	44	R1302	39	R1341	41	R1378	42	U1313	39	Y1300	39
C1363	42	R1302	41								



CURSOR/READOUT CPU DIAGRAM 39

Assembly A11

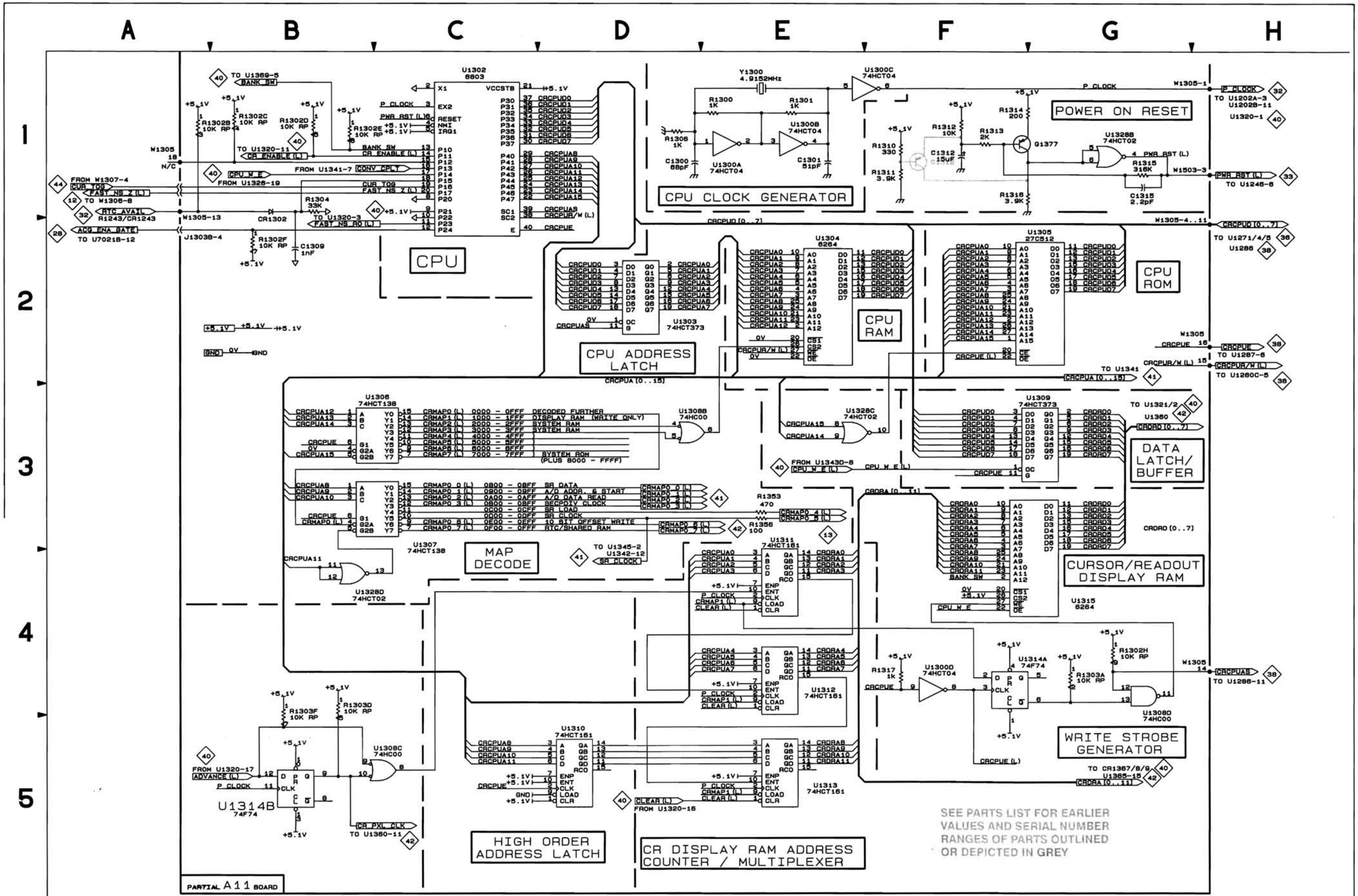
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1300	1D	6G
C1301	1E	5G
C1309	2B	3E
C1312	1F	2F
C1315	1G	2F
CR1302	1B	3E
Q1377	1F	2G
R1300	1E	5F
R1301	1E	5F
R1302B	1A	3F
R1302C	1B	3F
R1302D	1B	3F
R1302E	1B	3F

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1302F	2B	3F
R1302H	4G	3F
R1303A	4G	5E
R1303D	4B	5E
R1303F	4B	5E
R1304	1B	2E
R1306	1D	5G
R1310	1F	2F
R1311	1F	2F
R1312	1F	2E
R1313	1F	2F
R1314	1F	2F
R1315	1G	2F
R1316	1F	3F
R1317	4F	3E
R1353	3E	7D

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1356	3E	7E
U1300A	1E	5F
U1300B	1E	5F
U1300C	1E	5F
U1300D	4F	5F
U1302	1C	4F
U1303	2D	2E
U1304	2E	2C
U1305	2F	4C
U1306	3B	4D
U1307	3B	4D
U1308B	3D	5C
U1308C	5B	5C
U1308D	4G	5C

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
U1309	3F	4B
U1310	5D	3B
U1311	4E	3B
U1312	4E	4B
U1313	5E	4B
U1314A	4F	6F
U1314B	5B	6F
U1315	3F	5C
U1328B	1G	2F
U1328C	3E	2F
U1328D	4B	2F
W1305	1A	4D
Y1300	1E	5G

Partial A11 also shown on diagrams 40, 41, 42, 43 and 44.



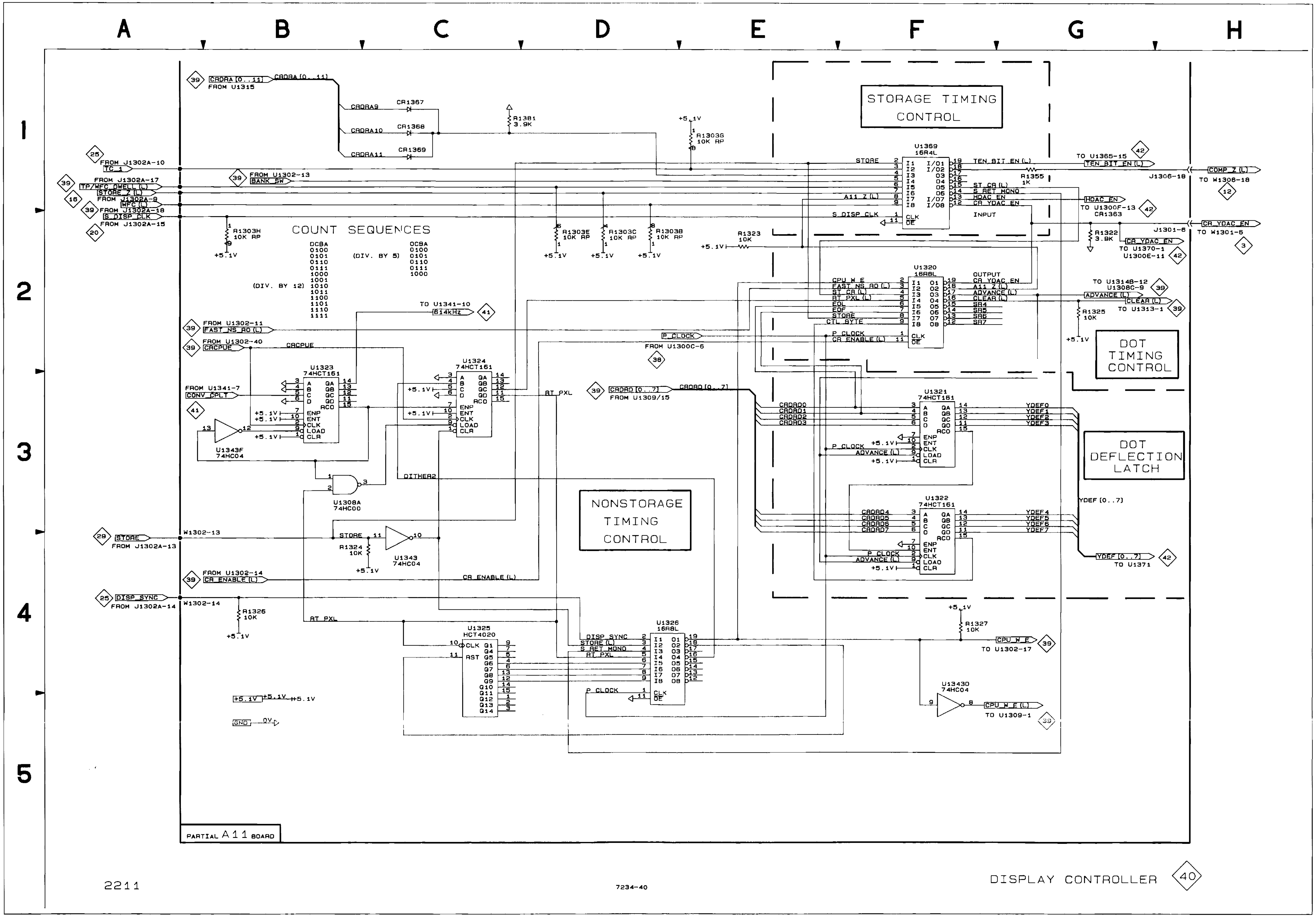
CPU
CPU CLOCK GENERATOR
POWER ON RESET
CPU ADDRESS LATCH
CPU RAM
CPU ROM
DATA LATCH/ BUFFER
MAP DECODE
CURSOR/READOUT DISPLAY RAM
WRITE STROBE GENERATOR
HIGH ORDER ADDRESS LATCH
CR DISPLAY RAM ADDRESS COUNTER / MULTIPLEXER
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY
PARTIAL A11 BOARD

DISPLAY CONTROLLER DIAGRAM 40

Assembly A11

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
CR1367	1C	6C	R1303H	2B	5E	R1381	1C	6D	U1324	3C	5F
CR1368	1C	5C	R1322	2G	5E				U1325	4C	6E
CR1369	1C	6C	R1323	2E	5D	U1308A	3B	5C	U1326	4D	5E
			R1324	4C	6F	U1320	2F	5D	U1343D	5F	5E
R1303B	2D	5E	R1325	2G	5C	U1321	3F	6D	U1343E	3C	5E
R1303C	2D	5E	R1326	4B	6E	U1322	3F	6C	U1343F	3B	5E
R1303E	2D	5E	R1327	4F	5E	U1323	3B	2B	U1369	1F	6E
R1303G	1E	5E	R1355	1G	7E						

Partial A11 also shown on diagrams 39, 41, 42, 43 and 44.

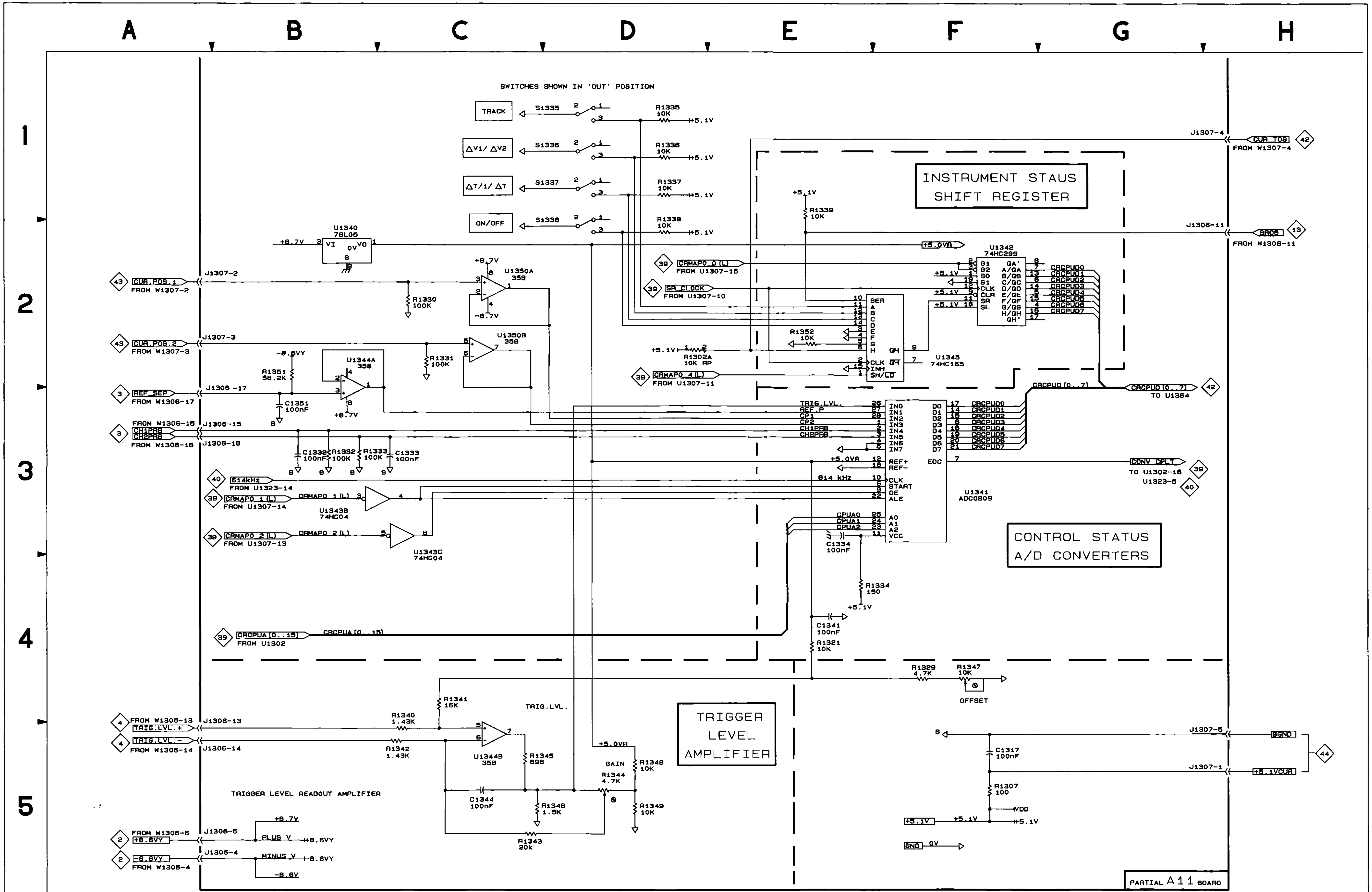

STORAGE TIMING CONTROL
NONSTORAGE TIMING CONTROL
DOT TIMING CONTROL
DOT DEFLECTION LATCH
COUNT SEQUENCES
PARTIAL A11 BOARD
U1369 16R4L
U1320 16R8L
U1321 74HCT161
U1322 74HCT161
U1323 74HCT161
U1324 74HCT161
U1325 HCT4020
U1326 16R8L
U1343 74HC04
U1308A 74HC00

CURSOR READOUT HOST INTERFACE DIAGRAM 41

Assembly A11

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1317	5F	7F	R1331	2C	6G	R1344	5D	5A	S1338	1D	2D
C1332	3B	8G	R1332	3B	8G	R1345	5C	7F			
C1333	3C	7G	R1333	3B	7G	R1346	5C	7F	U1340	2B	7A
C1334	3E	2G	R1334	4E	2G	R1347	4F	5A	U1341	3F	4G
C1341	4E	4G	R1335	1D	3D	R1348	5D	5A	U1342	2F	3B
C1344	5C	7F	R1336	1D	3D	R1349	5D	6A	U1343B	3B	5E
C1351	3B	7F	R1337	1D	3D	R1351	2B	7F	U1343C	3C	5E
			R1338	2D	3C	R1352	2E	1B	U1344A	2B	7G
R1302A	2D	3F	R1339	1E	2C				U1344B	5C	7G
R1307	5F	7F	R1340	5C	7F	S1335	1D	2E	U1345	2E	2B
R1321	4E	6A	R1341	4C	7F	S1336	1D	2D	U1350A	2C	6G
R1329	4F	5A	R1342	5C	7F	S1337	1D	2D	U1350B	2C	6G
R1330	2C	6F	R1343	5C	6F						

Partial A11 also shown on diagrams 39, 40, 42, 43 and 44.



2211

CURSOR READOUT HOST INTERFACE 41

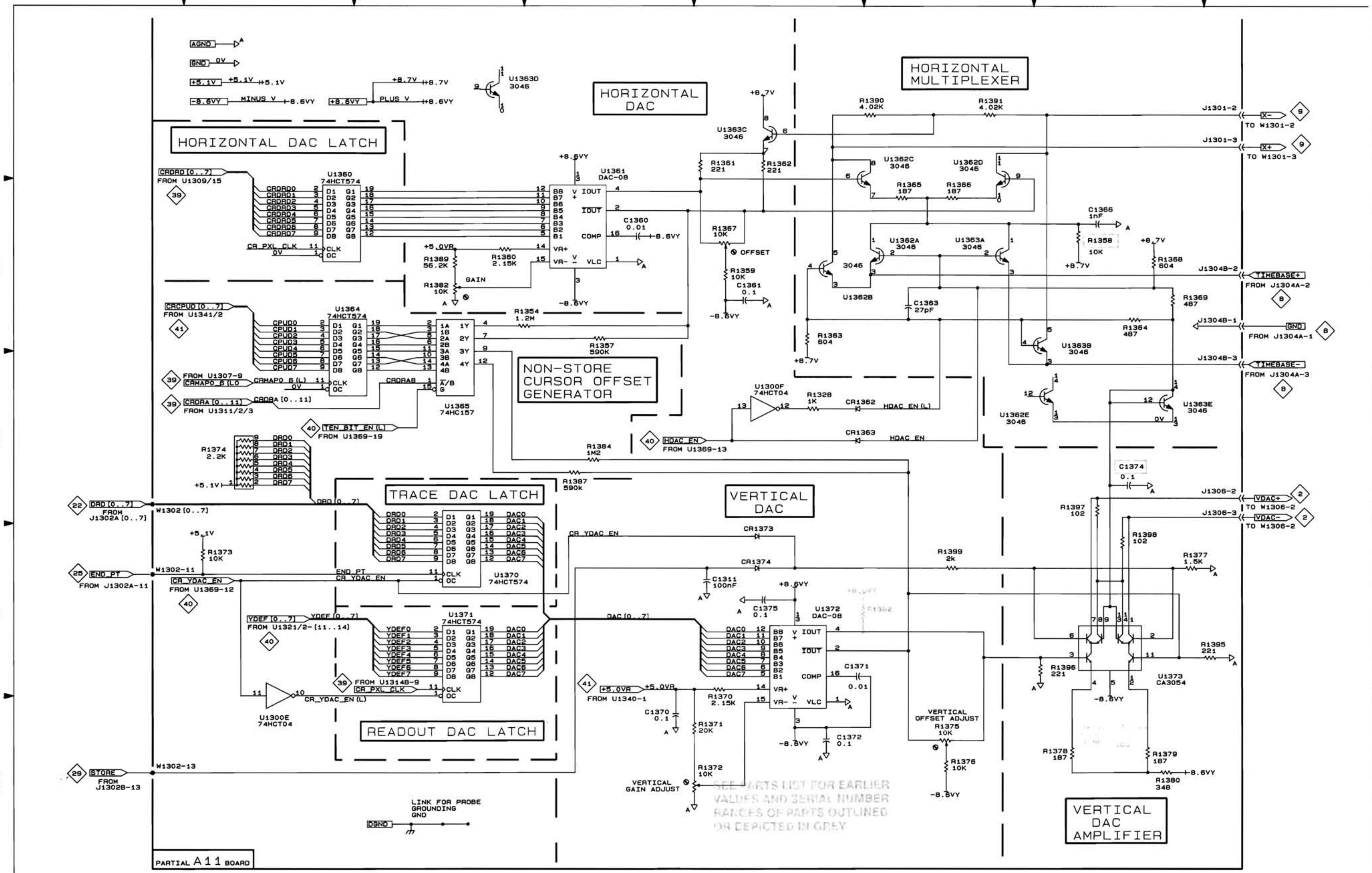
7234-41

X, Y MULTIPLEXERS & DRIVERS DIAGRAM 42

Assembly A11

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1311	4E	6E	R1357	2D	5B	R1376	5F	8A	U1300F	3E	5F
C1360	2D	6B	R1358	2G	7B	R1377	4G	7F	U1360	2B	5B
C1361	2E	6B	R1359	2E	6B	R1378	5G	7D	U1361	2D	6B
C1363	2F	7C	R1360	2C	6A	R1379	5G	7D	U1362A	2F	7B
C1366	2G	7B	R1361	1E	7B	R1380	5G	7D	U1362B	2E	7B
C1370	5D	5A	R1362	1E	7B	R1382	2C	6A	U1362C	1E	7B
C1371	4E	8C	R1363	2E	7B	R1384	3D	5A	U1362D	1F	7B
C1372	5E	8C	R1364	2G	7A	R1387	3D	5A	U1362E	3G	7B
C1375	4E	7C	R1365	2F	7C	R1389	2C	6A	U1363A	2F	7B
			R1366	2F	7B	R1390	1F	7C	U1363B	2F	7B
CR1362	3E	7C	R1367	2E	6A	R1391	1F	7B	U1363C	1E	7B
CR1363	3E	7C	R1368	2G	8B	R1393	5G	7C	U1363D	1C	7B
CR1373	4E	6F	R1369	2G	8B	R1395	4H	7B	U1363E	3G	7B
CR1374	4E	6F	R1370	4E	7C	R1396	4G	8B	U1364	2B	4A
			R1371	5D	4A	R1397	3G	7D	U1365	2C	5B
J1304B	3C	8C	R1372	5D	4A	R1398	4G	7D	U1370	3C	7E
			R1373	4B	6E	R1399	4F	7F	U1371	4C	6C
R1328	3E	6F	R1374	3B	6E				U1372	4E	7C
R1354	2C	5A	R1375	5F	6B	U1300E	4B	5F	U1373	4G	7D

Partial A11 also shown on diagrams 39, 40, 41, 43 and 44.



2211

X, Y MULTIPLEXERS & DRIVERS 42

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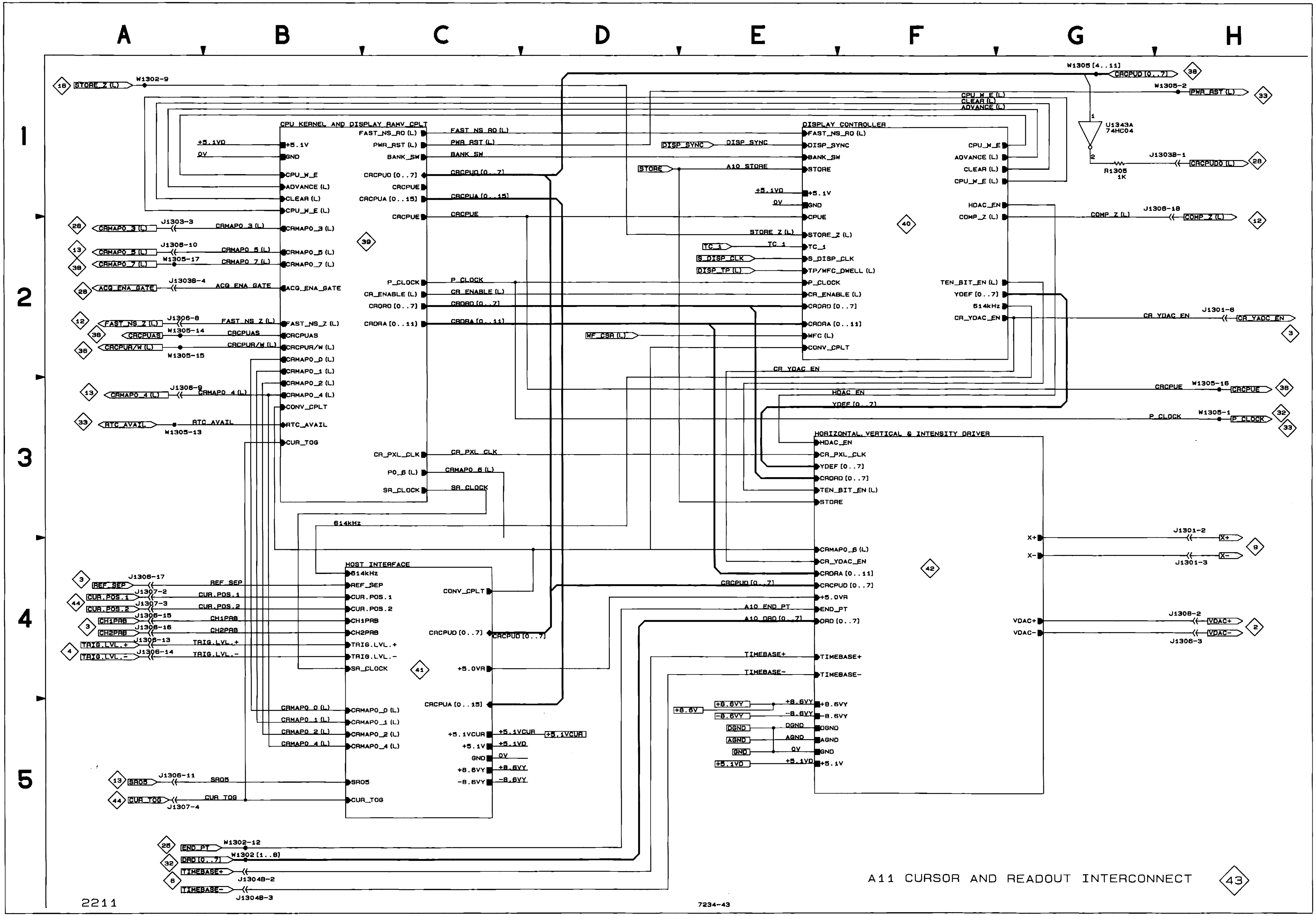
CURSOR AND READOUT INTERCONNECT DIAGRAM 43

Assembly A11

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1305	1G	4D	U1343A	1G	5E						

Partial A11 also shown on diagrams 39, 40, 41, 42 and 44.


CPU KERNEL AND DISPLAY RAMV CPLT
DISPLAY CONTROLLER
HOST INTERFACE
HORIZONTAL, VERTICAL & INTENSITY DRIVER
U1343A 74HC04
R1305 1K
A11 CURSOR AND READOUT INTERCONNECT
43
2211
7234-43

A11 INTERCONNECT DIAGRAM 44

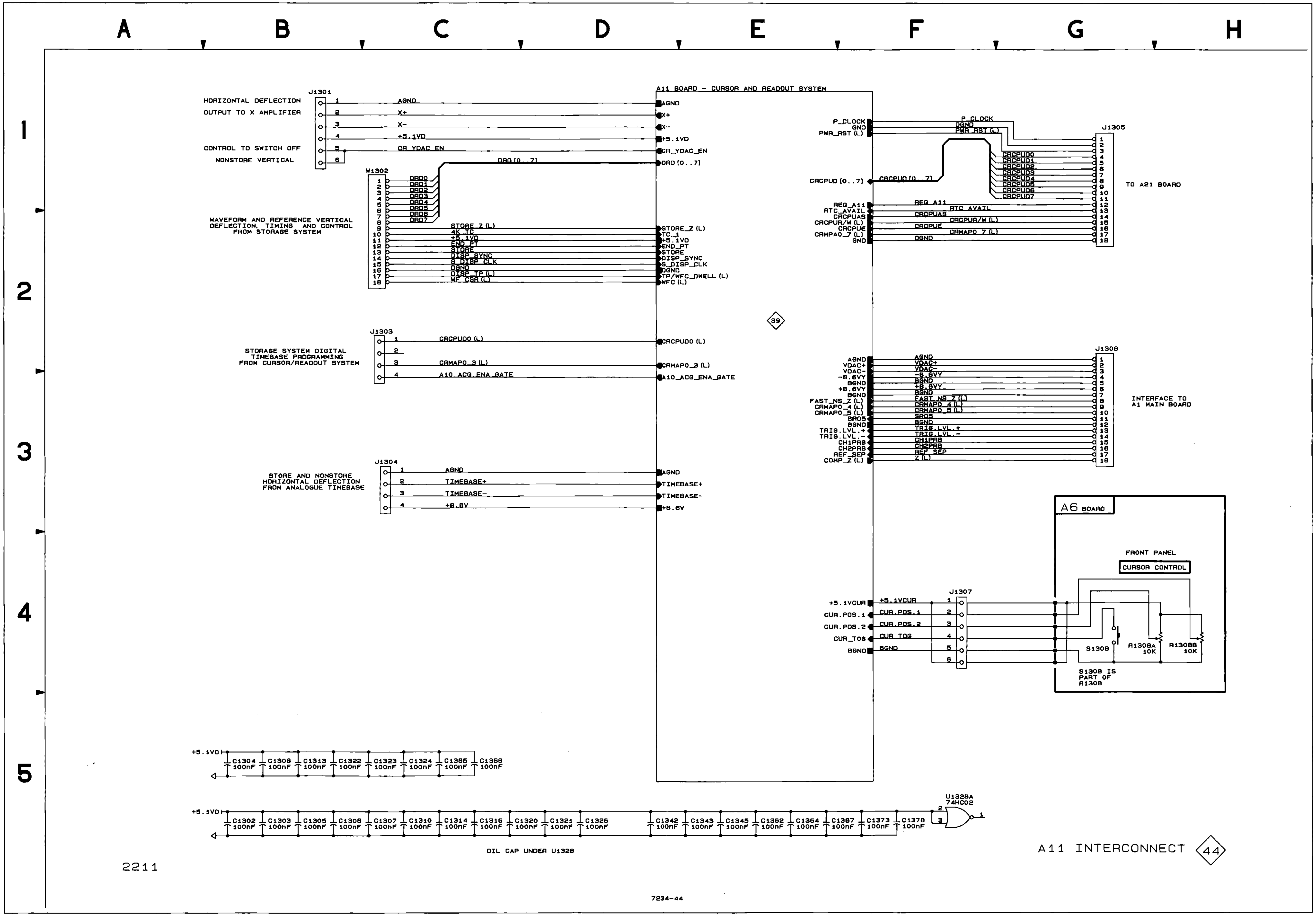
Assembly A6

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R1308A	4G	1A	R1308B	4G	1A	S1308	4H	1A			

Assembly A11

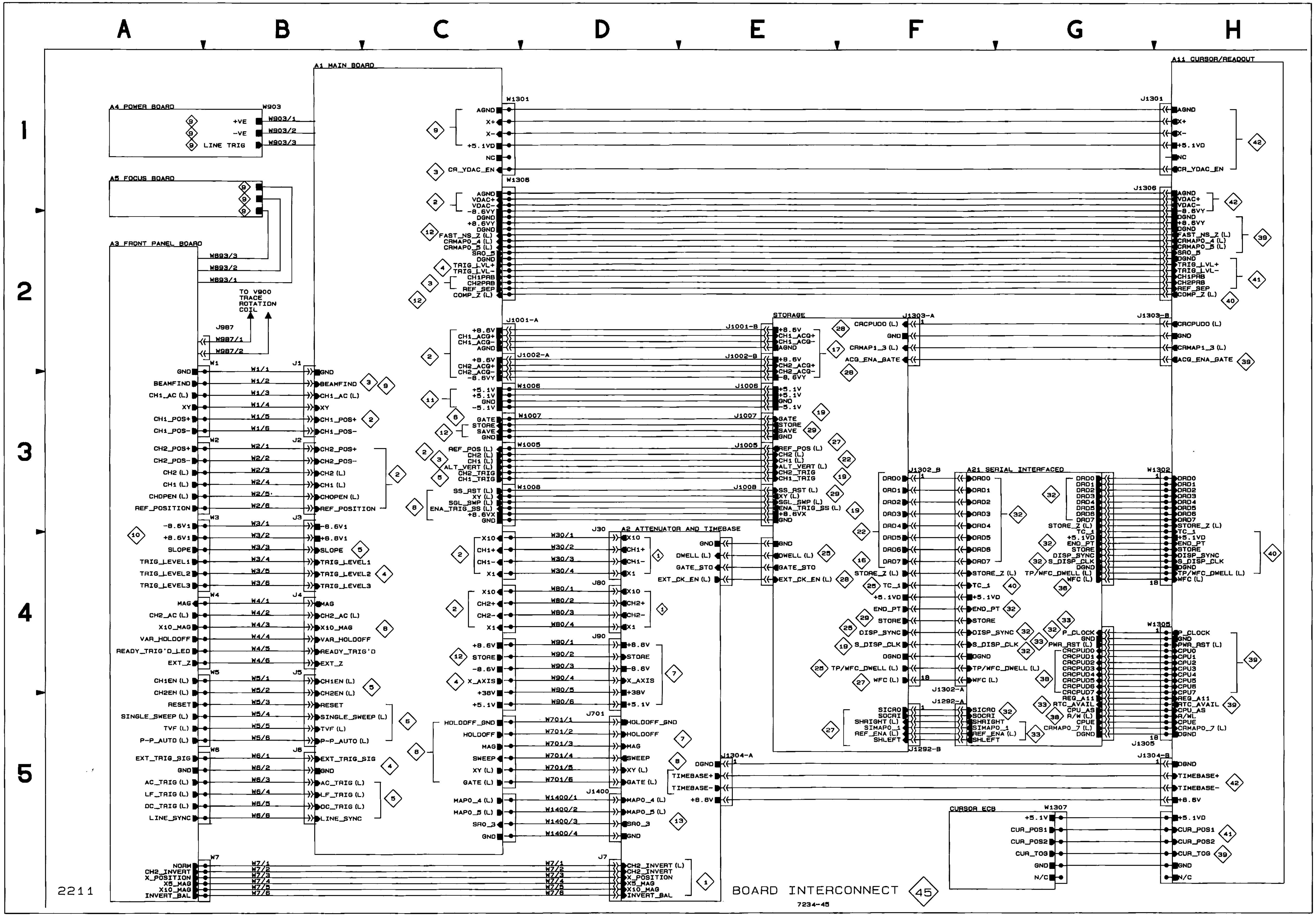
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1302	5B	4F	C1316	5C	6F	C1362	5E	5B	J1304	3C	8C
C1303	5B	2E	C1320	5C	5D	C1364	5E	4A	J1306	2G	8D
C1304	5B	2C	C1321	5D	6D	C1365	5C	4A	J1307	4F	8E
C1305	5B	4C	C1322	5B	6C	C1367	5E	6F			
C1306	5B	4D	C1323	5C	2B	C1368	5C	6E	R1307C	4G	7F
C1307	5C	4D	C1324	5C	5F	C1373	5F	6C			
C1308	5B	5C	C1326	5D	5D	C1378	5F	7E	U1328A	5F	2F
C1310	5C	3B	C1342	5D	3A						
C1313	5B	4B	C1343	5E	5E	J1301	1B	8D	W1302	1C	7E
C1314	5C	6D	C1345	5E	2B	J1303	2C	4F			

Partial A11 also shown on diagrams 39, 40, 41, 42 and 43.



A11 INTERCONNECT 44

2211


A B C D E F G H
1 2 3 4 5
A1 MAIN BOARD
A4 POWER BOARD
A5 FOCUS BOARD
A3 FRONT PANEL BOARD
A2 ATTENUATOR AND TIMEBASE
STORAGE
A21 SERIAL INTERFACED
A11 CURSOR/READOUT
CURSOR ECB
TO V900 TRACE ROTATION COIL
W903 W1301 J1301 W1306 J1306 J1001-A J1001-B J1002-A J1002-B J1303-A J1303-B W1006 J1006 W1007 J1007 W1005 J1005 W1008 J1008 J1302-B J1302-A W1302 W1305 J1305 J1292-A J1292-B J1304-A J1304-B W1307 J987 W893 W1 J1 W2 J2 W3 J3 W4 J4 W5 J5 W6 J6 W7 J7 J30 J80 J90 J701 J1400
2211
BOARD INTERCONNECT 45
7234-45

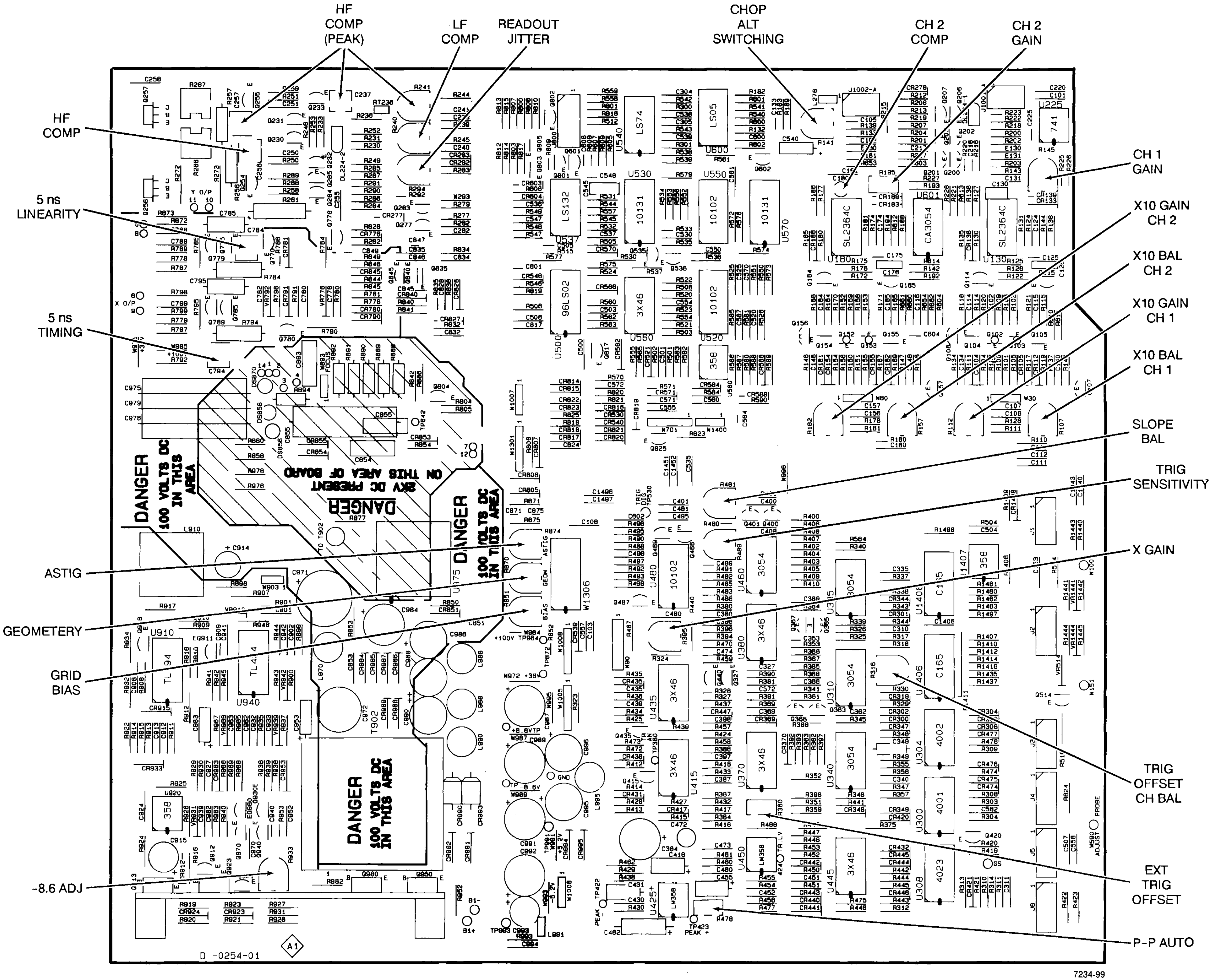


Figure 9-16. A1—Main board adjustment locations.

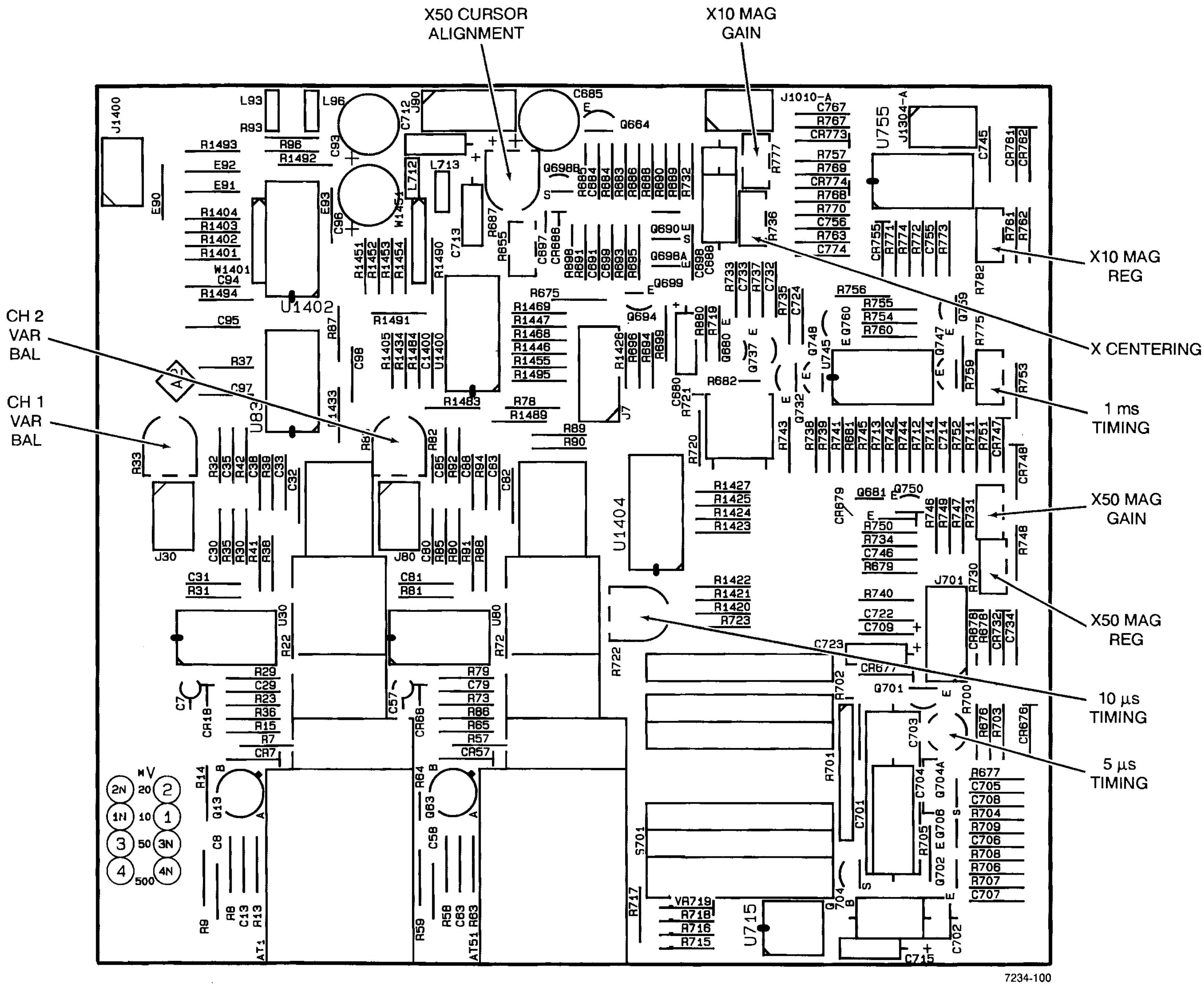


Figure 9-17. A2—Atten/Timebase board adjustment locations.

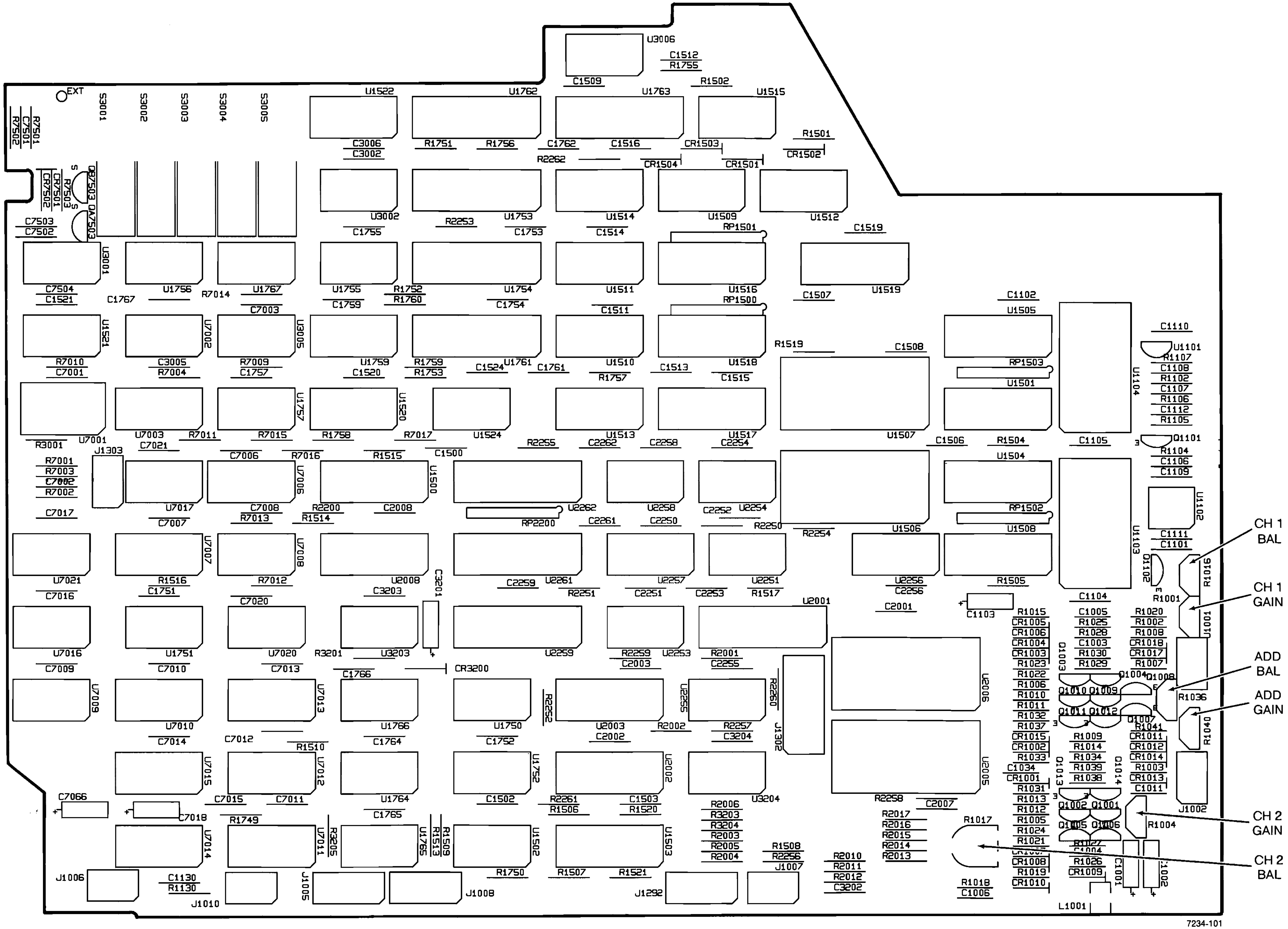


Figure 9-18. A10—Storage board adjustment locations.

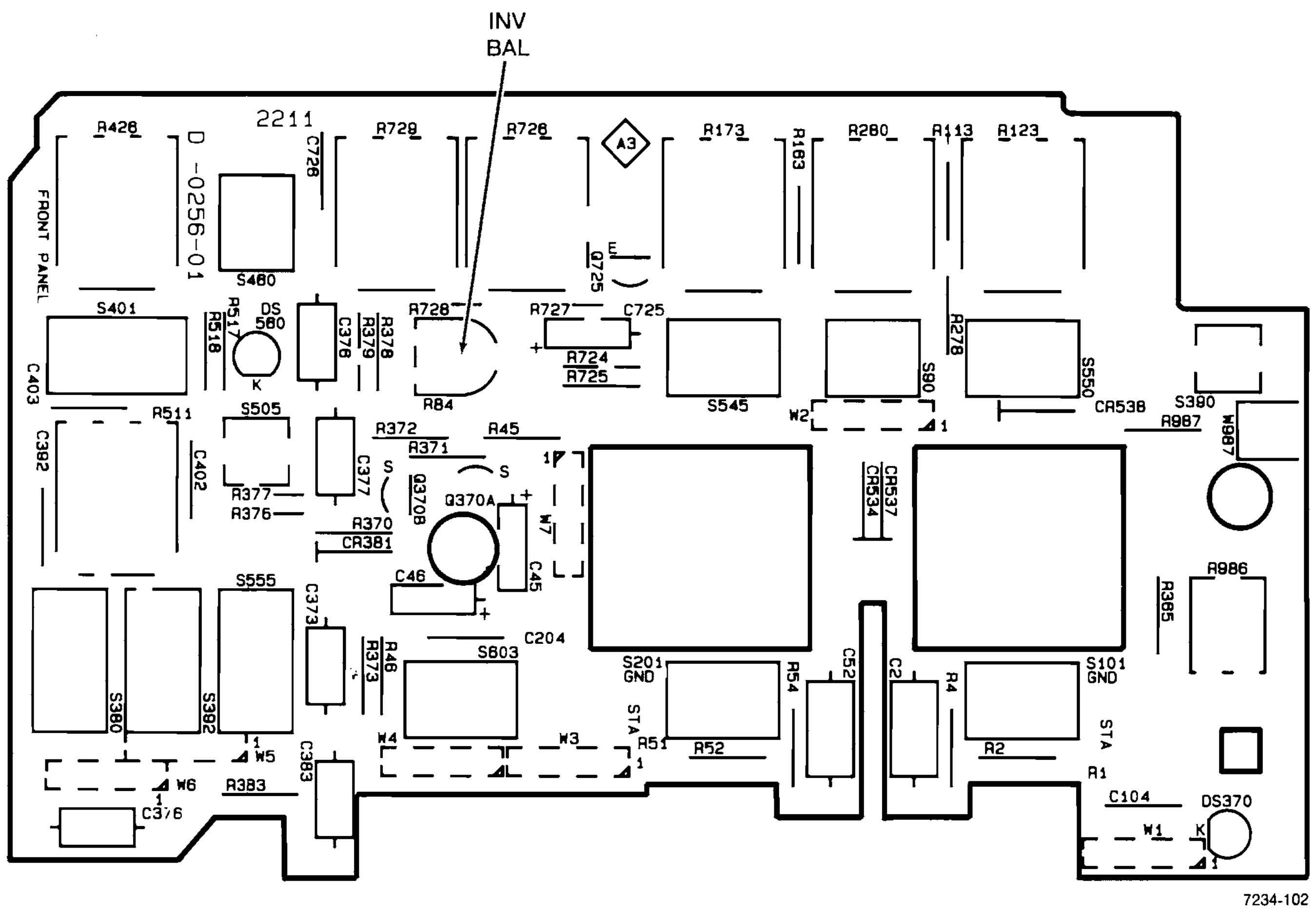


Figure 9-19. A3—Front Panel board adjustment locations.

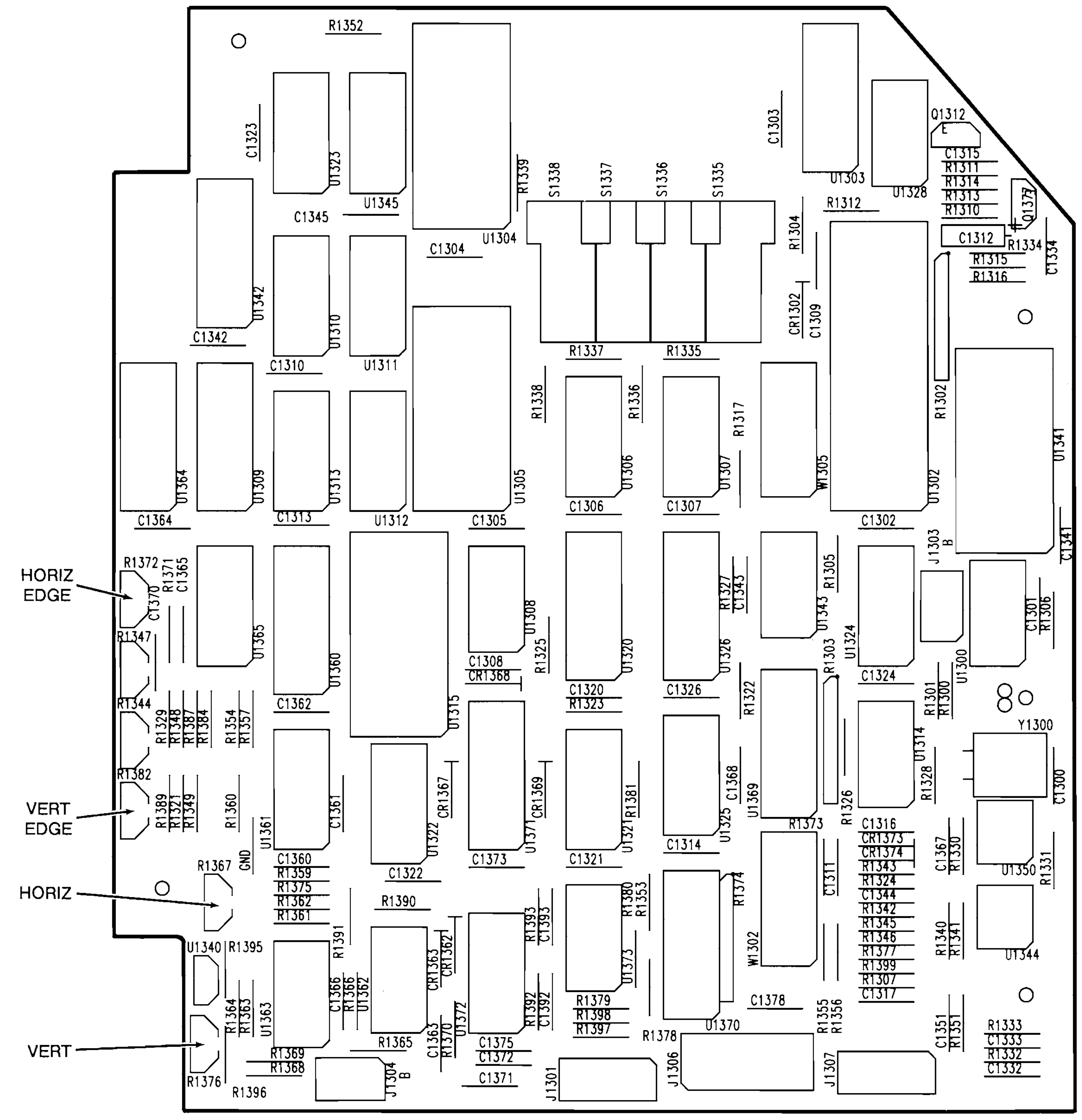


Figure 9-20. A11—Cursor Readout board adjustment locations.

REPLACEABLE MECHANICAL PARTS

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

When ordering parts, 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.

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.

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 indentations system used in the description column.

1 2 3 4 5 Name & Description

Assembly and/or component
Attaching parts for assembly and/or component

END ATTACHING PARTS

Detail part of assembly and/or component
Attaching parts for detail part

END ATTACHING PARTS

Parts of detail part
Attaching parts for parts or detail part

END ATTACHING PARTS

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.

Attaching parts must be purchased separately, unless otherwise specified.

ABBREVIATIONS

Abbreviations conform to American National Standard Y1.1.

CROSS INDEX – MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
K5545	AVEL LINDBERG LTD AVELEY INDUSTRIAL EST.	ARCANY ROAD SOUTH OCKENDON	ESSEX ENGLAND
S0319	MITSUBISHI ELECTRIC CORP	2–2–3 MARUNOUCHI CHIYODA–KU	TOKYO JAPAN
S3109	FELLER	72 Veronica Ave Unit 4	Summerset NJ 08873
S3629	SCHURTER AG H C/O PANEL COMPONENTS CORP	2015 SECOND STREET	BERKELEY CA 94170
TK0EC	CARON ENG. SERVICE	10–11 STATION CLOSE POTTERS BAR	HERTS ENGLAND
TK0EH	HARLOW SPRINGS 1 + 2 ROYDONBURY IND EST THE PINNACLES	HARLOW	ESSEX ENGLAND
TK0EI	HIBBERTS & RICHARDS UNIT A	LANCASTER ROAD NEW BARNET	HERTS ENGLAND
TK0EJ	IMP WORKS	ESSEX ROAD HODDESDON	HERTS ENGLAND
TK0EL	MOLBRY LTD	HOLLAND WAY BLANDFORD	DORSET ENGLAND
TK0EO	PLANET JIG & TOOL	BAKER STREET HIGH WYCOMBE	BUCKS ENGLAND
TK0ES	SMALL POWER MACHINE CO INDUSTRIAL ESTATE	BATH ROAD CHIPPENHAM	WILTSHIRE ENGLAND
TK0435	LEWIS SCREW CO	4300 S RACINE AVE	CHICAGO IL 60609–3320
TK0858	STAUFFER SUPPLY CO (DIST)	810 SE SHERMAN	PORTLAND OR 97214
TK0860	LABEL GRAPHICS	6700 SW BRADBURY CT	PORTLAND OR 97224
TK1326	NORTHWEST FOURSLIDE INC	18224 SW 100TH CT	TUALATIN OR 97062
TK1372	ELECTRI–CORD MFG CO INC	312 EAST MAIN ST	WESTFIELD PA 16950
TK1499	AMLAN INC	97 THORNWOOD RD	STAMFORD CT 06903–2617
TK1572	RAN–ROB INC	631 85TH AVE	OAKLAND CA 94621–1254
TK1650	AMP INC	19200 STEVENS CREEK BLVD SUITE 100	CUPERTINO CA 95014
TK1665	PORTLAND DIE AND STAMPING INC	4805 SE 26TH	PORTLAND OR 97202
TK1694	ROSE CITY LABEL CO	7235 SE LABEL LN	PORTLAND OR 97213
TK1723	MAGNETIC SHIELDS LTD	HEADCORD ROAD STAPLEHURST, TONBRIDGE	KENT TN 12 ODS ENGLAND
TK1725	GREENPAR CONNECTORS LTD	PO BOX 15 HARLOW	ESSEX CM20 2ER ENGLAND
TK2165	TRIQUEST CORP	3000 LEWIS AND CLARK HWY	VANCOUVER WA 98661–2999
TK2278	COMTEK MANUFACTURING OF OREGON (METALS)	PO BOX 4200	BEAVERTON OR 97076–4200
0JRZ2	BADGLEY MFG CO	1620 NE ARGYLE	PORTLAND OR 97211
04713	MOTOROLA INC SEMICONDUCTOR PRODUCTS SECTOR	5005 E MCDOWELL RD	PHOENIX AZ 85008–4229
06915	RICHCO PLASTIC CO	5825 N TRIPP AVE	CHICAGO IL 60646–6013
07416	NELSON NAME PLATE CO	3191 CASITAS	LOS ANGELES CA 90039–2410
12327	FREEWAY CORP	9301 ALLEN DR	CLEVELAND OH 44125–4632
12697	CLAROSTAT MFG CO INC	LOWER WASHINGTON ST	DOVER NH 03820

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
34416	PARSONS MFG CORP	1055 OBRIAN DR	MENLO PARK CA 94025-1408
70903	COOPER BELDEN ELECTRONICS WIRE AND CABLE SUB OF COOPER INDUSTRIES INC	2000 S BATAVIA AVE	GENEVA IL 60134-3325
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD	COLD SPRING KY 41076-9749
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077-0001

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1 -1	334-7471-00			1	MARKER,IDENT:MKD CAUTION	80009	334747100
-2	334-7472-00			1	MARKER,IDENT:MKD VOLTAG/FUSE SELECTION	80009	334747200
-3	334-5257-00			1	MARKER,IDENT:MKD X-RAY	TK1694	ORDER BY DESCRI
	334-5258-00			1	MARKER,IDENT:MKD X-RAY WARNING,GERMAN	TK1694	ORDER BY DESCRI
-4	200-3335-01			1	COVER,REAR	TK2165	ORDER BY DESCRI
					ATTACHING PARTS		
-5	211-0712-00			2	SCR,ASSEM WSHR:6-32 X 1.25,PNH,STL,TORX	TK0858	ORDER BY DESCRI
					END ATTACHING PARTS		
-6	343-1278-00			2	RTNR,POWER CORD:POLYCARBONATE GRAY	TK2165	ORDER BY DESCRI
-7	348-0964-00			2	FOOT,REAR COVER:BLACK,PLASTIC	TK0EJ	ORDER BY DESCRI
-8	334-7492-00			1	MARKER,IDENT:MARKED VOLTAGE/FUSE SELECT	80009	334749200
-9	390-1036-01			1	CABINET,OSC	80009	390103601
					ATTACHING PARTS		
-10	213-0882-00			2	SCREW,TPG,TR:6-32 X 0.437 TAPTITE,PNH,STL	TK0858	ORDER BY DESCRI
					END ATTACHING PARTS		
-11	367-0356-00			1	HANDLE,CARRYING	TK0EJ	ORDER BY DESCRI
					ATTACHING PARTS		
-12	212-0144-00			2	SCREW,TPG,TF:8-16 X 0.562 L,PLASTITE,SPCL HD	TK0858	ORDER BY DESCRI
-13	214-3984-00			7	SPRING,HLCPS:0.71 OD X 12.0MM L,OPEN ENDS	TK0EH	ORDER BY DESCRI
					END ATTACHING PARTS		
-14	334-7398-00			1	PLATE,IDENT:MARKED TEKTRONIX	80009	334739800
-15	426-1765-00			1	FRAME,CRT:POLYCARBONATE,GRAY	80009	426176500
					ATTACHING PARTS		
-16	211-0690-01			2	SCREW,MACHINE:6-32 X 0.875 PNH,SST	TK0858	ORDER BY DESCRI
					END ATTACHING PARTS		
-17	337-2775-00			1	SHLD,IMPLOSION:FILTER,BLUE	TK2165	ORDER BY DESCRI
-18	348-0660-00			4	CUSHION,CRT:POLYURETHANE	80009	348066000
-19	384-1575-00			1	EXTENSION SHAFT:8.805 L,W/KNOB,PLASTIC	TK2165	ORDER BY DESCRI
-20	358-0550-00			1	BUSHING,SHAFT:0.15 ID X 0.488 L,PLSTC	TK2165	ORDER BY DESCRI
-21	366-1480-03			1	PUSH BUTTON:BLACK,OFF	TK2165	ORDER BY DESCRI
-22	384-1364-00			1	EXTENSION SHAFT:10.818 L X 0.187 SQ,NYL,BLK	TK2165	ORDER BY DESCRI
-23	366-0641-00			2	KNOB:GY/YL,CAL/X10,11.5MM X 3.08MM X 13MM H	TK0ES	ORDER BY DESCRI
-24	366-0699-00			2	KNOB ASSEMBLY:VOLTS/DIV	80009	366069900
-25	210-1436-00			2	WASHER,FLAT:9.4MM ID X 12.5MM OD X 2MM THK, ALUMINUM	TK0EL	ORDER BY DESCRI
-26	366-0640-00			1	KNOB:GRAY,CAL W/ARROW,10MM X 2MM X 12MM H	TK0ES	ORDER BY DESCRI
-27	331-0499-00			1	DIAL,CONTROL:32MM X 3.75MM,MKD 2 X LINES	TK0EJ	ORDER BY DESCRI
-28	131-0679-02			1	CONN,RCPT,ELEC:BNC,FEMALE,3 CONTACT	TK1650	222189-1
	210-0241-00			1	TERMINAL,LUG:0.515 ID,PLAIN,STL CD PL	TK1665	ORDER BY DESCRI
	210-1039-00			1	WASHER,LOCK:0.521 ID,INT,0.025 THK,SST	TK0858	1224-02-00-0541
	220-0497-00			1	NUT,PLAIN,HEX:0.5-28 X 0.562 HEX,BRS CD PL	73743	ORDER BY DESCRI
-29	366-0636-00			8	KNOB:GRAY,10MM X 12MM H	TK0EJ	ORDER BY DESCRI
-30	366-0635-00			2	PUSH BUTTON:GRAY,4.45MM X 7.75MM X	TK0EJ	ORDER BY DESCRI
-31	--------			1	TERMINAL,FEEDTHRU: (SEE J590 REPL)		
-32	--------			3	CONN,RCPT,ELEC:BNC (SEE J100,J151,J300 REPL)		
-33	210-0255-00			3	TERMINAL,LUG:0.391 ID,LOCKING,BRS CD PL	TK1572	ORDER BY DESCRI
-34	366-1391-03			1	KNOB:DOVE GRAY,0.081 ID X 0.28 OD X 0.32 H	TK2278	ORDER BY DESCRI
-35	366-1879-00			1	SHELL,KNOB:GRAY 0.5 OD X 0.531 H PLSTC	TK2165	ORDER BY DESCRI
-36	366-1708-03			1	KNOB:SIL GY,0.127 ID X 0.5 OD X 0.531 H	TK2165	ORDER BY DESCRI
-37	386-5483-02			1	SUBPANEL,FRONT	80009	386548302
-38	333-3669-00			1	PANEL,FRONT	80009	333366900

FIG. 1 CABINET

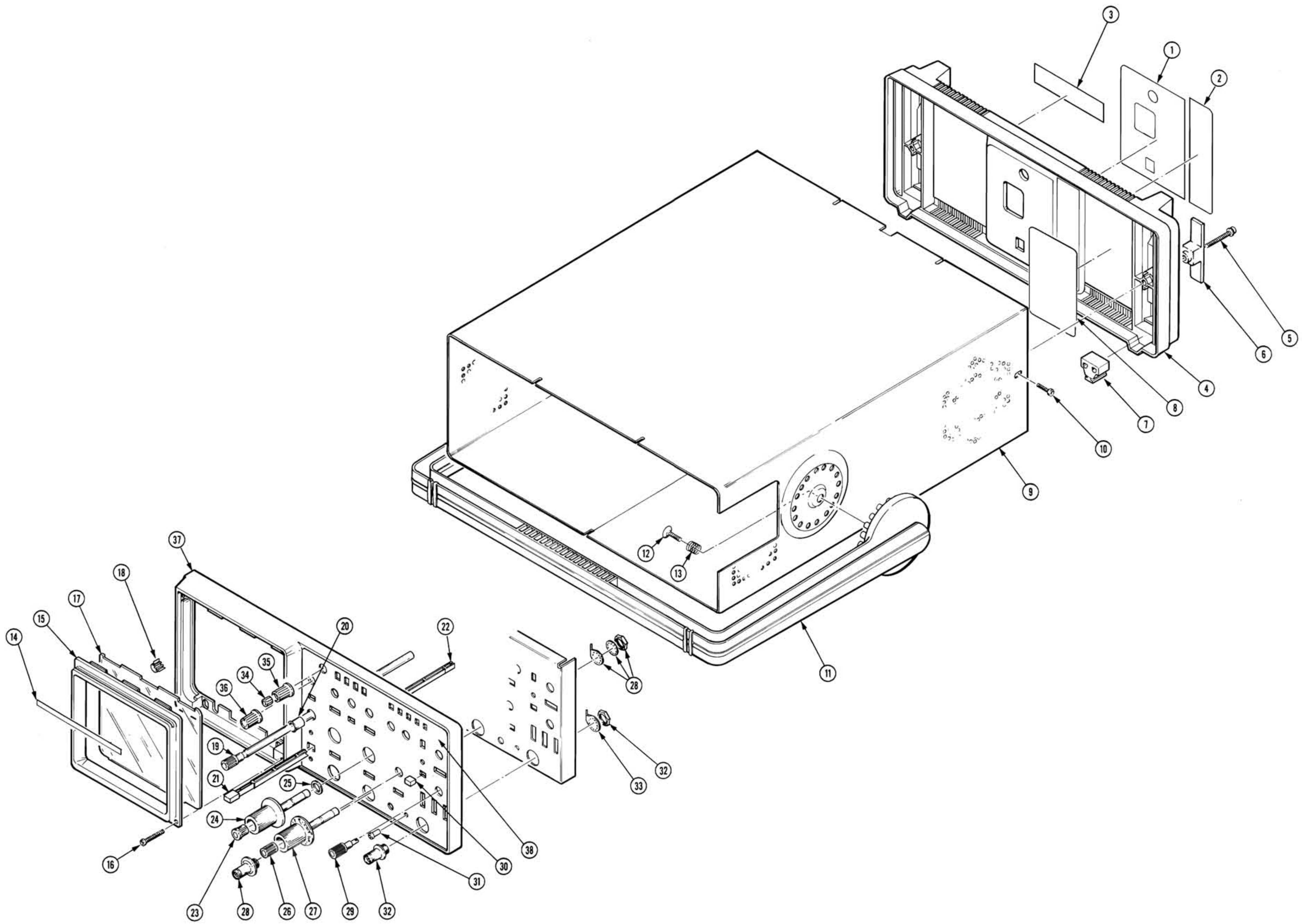


FIG. 2 CHASSIS

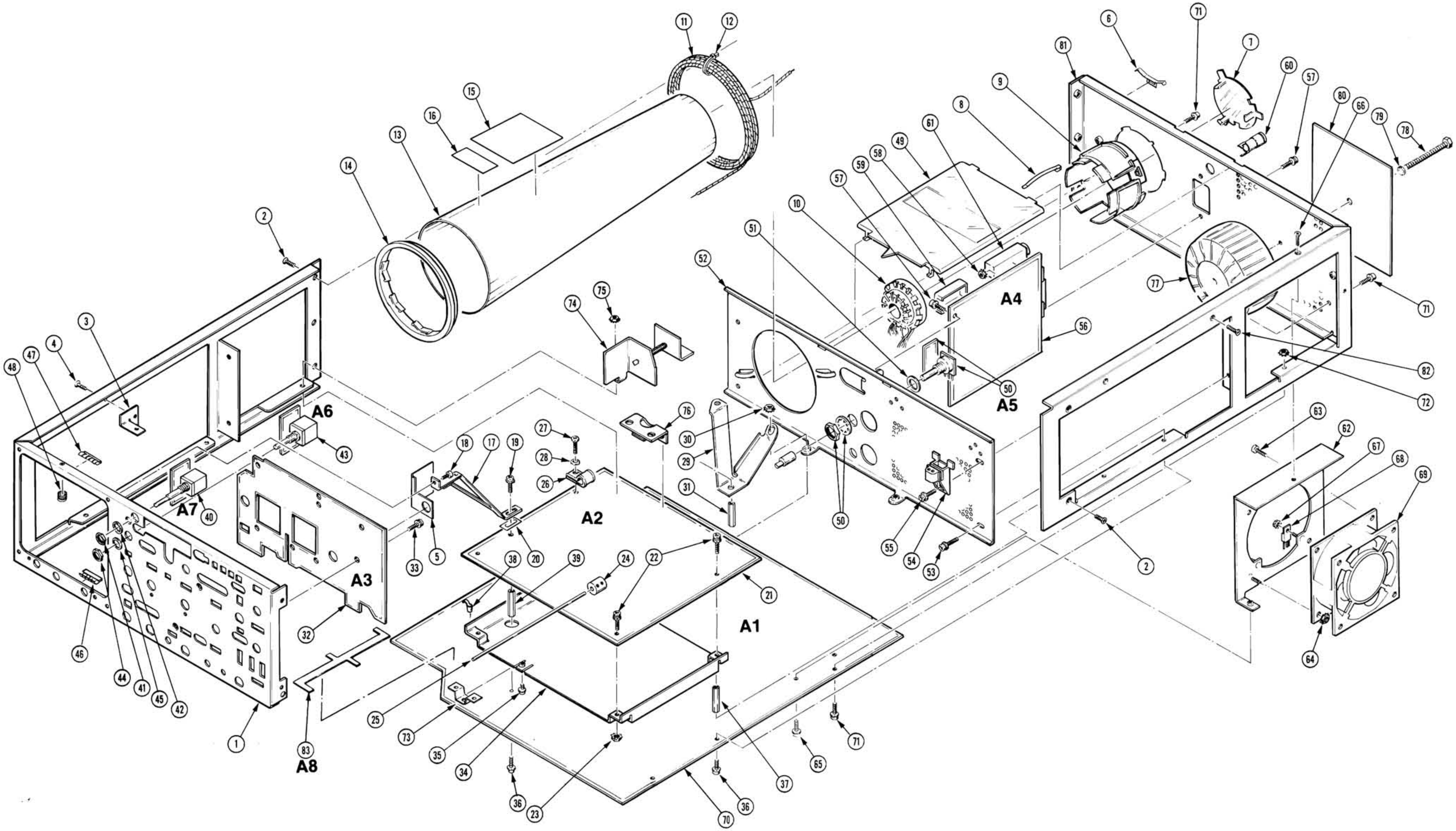


Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2 -1	441-1752-02			1	CHASSIS,SCOPE:FRONT	80009	441175202
					ATTACHING PARTS		
-2	211-0718-00			4	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	TK0858	ORDER BY DESCRI
					END ATTACHING PARTS		
-3	407-3698-00			1	BRACKET,CKT BD:CHASSIS SIDE,STL	TK0E0	ORDER BY DESCRI
					ATTACHING PARTS		
-4	211-0718-00			1	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL	TK0858	ORDER BY DESCRI
					END ATTACHING PARTS		
-5	337-3548-00			1	SHIELD,ELEC:CH 1 & CH 2	80009	337354800
-6	214-4155-00			5	SPRING,GROUND:PH BR,NI PL	TK0E0	ORDER BY DESCRI
-7	200-2519-00			1	CAP,CRT SOCKET:NATURAL LEXAN	80009	200251900
-8	214-1061-05			1	SPRING,GROUND:PLATED	TK1326	ORDER BY DESCRI
-9	426-1766-00			1	MOUNT,RESILIENT:CRT,REAR	80009	426176600
-10	136-0202-04			1	SKT,PL-IN ELEK:ELECTRON TUBE,14 CONTACT	TK2165	136-0202-04
-11	--------			1	DELAY LINE,ELEC:(SEE A1DL224 REPL)		
-12	343-0549-00			1	STRAP,TIEDOWN,E:0.098 W X 4.0 L,ZYTEL	TK1499	HW-047
-13	337-3363-00			1	SHIELD,ELEC:CRT	TK1723	ORDER BY DESCRI
-14	386-4443-00			1	SUPPORT,SHIELD:CRT,FRONT,PLASTIC	80009	386444300
-15	334-1951-00			1	MARKER,IDENT:MKD WARNING,CRT VOLTAGES	TK0860	ORDER BY DESCRI
-16	334-1379-00			1	MARKER,IDENT:MKD HI VACUUM	07416	ORDER BY DESCRI
-17	386-5891-00			1	SUPPORT,CKT BD	80009	386589100
					ATTACHING PARTS		
-18	211-0730-00			1	SCR,ASSEM WSHR:6-32 X 0.375,PNH,STL CD PL, TORX T15	TK0858	ORDER BY DESCRI
-19	213-0882-00			1	SCREW,TPG,TR:6-32 X 0.437 TAPTITE,PNH,STL	TK0858	ORDER BY DESCRI
					END ATTACHING PARTS		
-20	337-3422-00			1	SHIELD,ELEC	TK0EJ	ORDER BY DESCRI
-21	--------				CIRCUIT BD ASSY:ATTEN/T.B. (SEE A2 REPL)		
					ATTACHING PARTS		
-22	211-0730-00			3	SCR,ASSEM WSHR:6-32 X 0.375,PNH,STL CD PL, TORX T15	TK0858	ORDER BY DESCRI
-23	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	TK0435	ORDER BY DESCRI
					END ATTACHING PARTS		
-24	376-0224-01			1	CPLG,SHAFT,RGD:W/213-0153-00	TK0EC	ORDER BY DESCRI
-25	384-1740-00			1	SHAFT,EXTENSION:2MM OD X 145.7MM L	80009	384174000
-26	343-0003-00			1	CLAMP,LOOP:0.25 ID,PLASTIC	06915	E4 CLEAR ROUND
					ATTACHING PARTS		
-27	211-0730-00			1	SCR,ASSEM WSHR:6-32 X 0.375,PNH,STL CD PL, TORX T15	TK0858	ORDER BY DESCRI
-28	210-0803-00			1	WASHER,FLAT:0.15 ID X 0.375 OD X 0.032,STL	12327	ORDER BY DESCRI
					END ATTACHING PARTS		
-29	407-3837-00			1	BRACKET,SUPPORT:CIRCUIT BD	80009	407383700
					ATTACHING PARTS		
-30	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	TK0435	ORDER BY DESCRI
					END ATTACHING PARTS		
-31	129-1105-00			1	SPACER,POST:23.5MM L,4-40 BOTH ENDS,AL,HEX	TK0EL	ORDER BY DESCRI
-32					CIRCUIT BD ASSY:FRONT PNL (SEE A3 REPL)		
					ATTACHING PARTS		
-33	211-0304-00			6	SCR,ASSEM WSHR:4-40 X 0.312,PNH,STL,T9 TORX	TK0858	ORDER BY DESCRI
					END ATTACHING PARTS		
-34	337-3365-00			1	SHIELD,ELEC:ATTENUATOR	TK0E0	ORDER BY DESCRI
					ATTACHING PARTS		
-35	211-0304-00			1	SCR,ASSEM WSHR:4-40 X 0.312,PNH,STL,T9 TORX	TK0858	ORDER BY DESCRI
-36	211-0730-00			3	SCR,ASSEM WSHR:6-32 X 0.375,PNH,STL CD PL, TORX T15	TK0858	ORDER BY DESCRI
-37	129-1105-00			1	SPACER,POST:23.5MM L,4-40 BOTH ENDS,AL,HEX	TK0EL	ORDER BY DESCRI
					END ATTACHING PARTS		
-38	343-0088-00			2	CLAMP,CABLE:0.062 DIA,PLASTIC	80009	343008800
-39	129-1106-00			1	SPACER,POST:25.4MM L,W 6-32 THD THRU,BRASS, 6.3MM HEX	TK0EL	ORDER BY DESCRI
-40	--------			1	INTENSITY CONTROL: (SEE A7R802 REPL)		

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
					ATTACHING PARTS		
2 –41	210–0583–00			1	NUT,PLAIN,HEX:0.25–32 X 0.312,BRS CD PL	73743	2X–20319–402
–42	210–0940–00			1	WASHER,FLAT:0.25 ID X 0.375 OD X 0.02,STL	12327	ORDER BY DESCRI
					END ATTACHING PARTS		
–43	--------			1	CURSOR CONTROL: (SEE A6R1308 REPL)		
					ATTACHING PARTS		
–44	210–0583–00			1	NUT,PLAIN,HEX:0.25–32 X 0.312,BRS CD PL	73743	2X–20319–402
–45	210–0940–00			1	WASHER,FLAT:0.25 ID X 0.375 OD X 0.02,STL	12327	ORDER BY DESCRI
					END ATTACHING PARTS		
–46	344–0367–01			1	CLIP,GROUND:CU–BE	TK1326	ORDER BY DESCRI
–47	344–0367–01			1	CLIP,GROUND:CU–BE	TK1326	ORDER BY DESCRI
–48	214–3984–00			1	SPRING,HLCPS:0.71 OD X 12.0MM L,OPEN ENDS	TK0EH	ORDER BY DESCRI
–49	337–3364–01			1	SHIELD,ELEC:POWER SUPPLY	TK0EJ	ORDER BY DESCRI
–50					CIRCUIT BD ASSY:FOCUS CONT (SEE A5 REPL)		
–51	210–1437–00			1	WASHER,FLAT:0.265 ID X 0.06 THK,STEEL	TK0EI	ORDER BY DESCRI
–52	441–1751–03			1	CHASSIS,SCOPE:INNER	80009	441175103
					ATTACHING PARTS		
–53	213–0882–00			2	SCREW,TPG,TR:6–32 X 0.437 TAPTITE,PNH,STL	TK0858	ORDER BY DESCRI
					END ATTACHING PARTS		
–54	407–3697–00			2	BRACKET,SUPPORT:CKT BD,PLASTIC	TK0EJ	ORDER BY DESCRI
					ATTACHING PARTS		
–55	213–0882–00			2	SCREW,TPG,TR:6–32 X 0.437 TAPTITE,PNH,STL	TK0858	ORDER BY DESCRI
					END ATTACHING PARTS		
–56	--------			1	CIRCUIT BD ASSY:POWER (SEE A4 REPL)		
					ATTACHING PARTS		
–57	211–0730–00			6	SCR,ASSEM WSHR:6–32 X 0.375,PNH,STL CD PL, TORX T15	TK0858	ORDER BY DESCRI
–58	210–0457–00			2	NUT,PL,ASSEM WA:6–32 X 0.312,STL CD PL	TK0435	ORDER BY DESCRI
					END ATTACHING PARTS		
–59	200–2735–00			1	COVER,POWER SW:BLACK,POLYCARBONATE	TK2165	ORDER BY DESCRI
–60	200–2264–00			1	CAP,FUSEHOLDER:3AG FUSES	S3629	FEK 031 1666
–61	204–0906–00			1	BODY,FUSEHOLDER:3AG & 5 X 20MM FUSES	S3629	TYPE FAU 031.35
–62	407–3699–01			1	BRACKET,HEAT SK:FAN MTG,ALUM	TK0EO	ORDER BY DESCRI
					ATTACHING PARTS		
–63	211–0730–00			2	SCR,ASSEM WSHR:6–32 X 0.375,PNH,STL CD PL, TORX T15	TK0858	ORDER BY DESCRI
–64	210–0457–00			2	NUT,PL,ASSEM WA:6–32 X 0.312,STL CD PL	TK0435	ORDER BY DESCRI
–65	211–0304–00			2	SCR,ASSEM WSHR:4–40 X 0.312,PNH,STL,T9 TORX	TK0858	ORDER BY DESCRI
–66	211–0718–00			3	SCREW,MACHINE:6–32 X 0.312,FLH,100 DEG,STL	TK0858	ORDER BY DESCRI
–67	210–0457–00			4	NUT,PL,ASSEM WA:6–32 X 0.312,STL CD PL	TK0435	ORDER BY DESCRI
					END ATTACHING PARTS		
–68	--------			4	TRANSISTOR: (SEE A1Q912,Q913,Q950,Q980 REPL)		
–69	--------			1	FAN,TUBAXIAL: (SEE A1B1 REPL)		
–70	--------			1	CIRCUIT BD ASSY:MAIN (SEE A1 REPL)		
					ATTACHING PARTS		
–71	211–0730–00			8	SCR,ASSEM WSHR:6–32 X 0.375,PNH,STL CD PL, TORX T15	TK0858	ORDER BY DESCRI
–72	210–0457–00			5	NUT,PL,ASSEM WA:6–32 X 0.312,STL CD PL	TK0435	ORDER BY DESCRI
					END ATTACHING PARTS		
–73	346–0240–00			1	STRAP,GROUND:ATTENUATOR	TK0EO	ORDER BY DESCRI
–74	214–4084–01			1	HT SK,XSTR ASSY	80009	214408401
					ATTACHING PARTS		
–75	220–0103–00			4	NUT:4–40,0.25,STL ZN PL	TK0EI	ORDER BY DESCRI
					END ATTACHING PARTS		
–76	407–3733–00			1	BRACKET,HEAT SK:ALUMINUM	TK0EO	ORDER BY DESCRI
–77	--------				TRANSFORMER,RF: (SEE T901 REPL)		
–78	213–1025–00			1	SCREW,MACHINE:1/2 X 20 X 0.75 L,HEX HD	TK0EI	ORDER BY DESCRI
–79	210–0093–00			1	WASHER,LOCK:0.25 INT,STL	TK0EI	ORDER BY DESCRI
–80	386–5361–00			1	PLATE,REAR:STEEL	TK0EO	ORDER BY DESCRI
–81	441–1753–02			1	CABINET,SCOPE: REAR	80009	441175302
–82	211–0718–00			2	SCREW,MACHINE:6–32 X 0.312,FLH,100 DEG,STL	TK0858	ORDER BY DESCRI
–83	--------			1	CIRCUIT BD ASSY:TRIG PICK OFF (SEE A8 REPL)		

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
3 –1	--------			1	CIRCUIT BD ASSY:STORAGE:(SEE A10 REPL)		
					ATTACHING PARTS		
–2	211–0690–01			1	SCREW,MACHINE:6–32 X 0.875 PNH,SST	TK0858	ORDER BY DESCRI
–3	213–0881–00			2	SCREW,TPG,TR:6–32 X 0.25 TYPE TT,FILH,STL	TK0858	ORDER BY DESCRI
–4	213–0882–00			4	SCREW,TPG,TR:6–32 X 0.437 TAPTITE,PNH,STL	TK0858	ORDER BY DESCRI
					END ATTACHING PARTS		
–5	214–4151–00			1	SPRING,GROUND:PH BR,NI PL	TK0EO	ORDER BY DESCRI
–6	214–4152–00			1	SPRING,GROUND:PH BR,NI PL	TK0EO	ORDER BY DESCRI
–7	214–4153–00			2	SPRING,GROUND:PH BR,NI PL	TK0EO	ORDER BY DESCRI
–8	366–0697–00			4	PUSH BUTTON:GRAY,OFFSET	80009	366069700
–9	--------				CIRCUIT BD ASSY:CURSER/READOUT (SEE A11 REPL)		
					ATTACHING PARTS		
–10	211–0730–00			1	SCR,ASSEM WSHR:6–32 X 0.375,PNH,STL CD PL, TORX T15	TK0858	ORDER BY DESCRI
					END ATTACHING PARTS		
–11	129–1291–00			1	SPACER,POST:20.65MM L X 6.3MM AF,BRASS HEX	80009	129129100
–12	--------			1	CIRCUIT BD ASSY:SERIAL INTFC (SEE A21 REPL)		
					ATTACHING PARTS		
–13	210–0457–00			1	NUT,PL,ASSEM WA:6–32 X 0.312,STL CD PL	TK0435	ORDER BY DESCRI
–14	129–1281–00			1	SPACER,POST:6–32 X 39.85,THD BOTH ENDS	80009	129128100
–15	210–0457–00			1	NUT,PL,ASSEM WA:6–32 X 0.312,STL CD PL	TK0435	ORDER BY DESCRI
					END ATTACHING PARTS		
–16	366–0698–01			1	PUSH BUTTON; GRAY	80009	366069801
–17	337–3585–01			1	SHIELD, ELEC: STORAGE ASSY	80009	337358501
–18	361–1519–00			1	SPACER,CRT BD: .47L,NYLON	80009	361151900
–19	210–1466–00			1	WASHER:SPECIAL	80009	210146600
–20	361–1519–00			1	SPACER,CRT BD: .47L,NYLON:	80009	361151900
–21	211–0730–00			1	SCR,ASSEM WSHR:6–32 X 0.375,PNH,STL CD PL, TORX T15	TK0858	ORDER BY DESCRI
–22	211–0691–00			1	SCREW,MACHINE:6–32 X 0.625,PNH,STL	TK0858	ORDER BY DESCRI
–23	211–0691–00			1	SCREW,MACHINE:6–32 X 0.625,PNH,STL	TK0858	ORDER BY DESCRI
–24	386–5712–01			1	SUBPANEL,SIDE:2210	80009	386571201
					ATTACHING PARTS		
–25	213–0882–00			1	SCREW,TPG,TR:6–32 X 0.437 TAPTITE,PNH,STL	TK0858	ORDER BY DESCRI
					END ATTACHING PARTS		
–26	214–4272–00			1	GROUNDING SPRING:PH BR	80009	214427200
–27	334–7351–00			1	OVERLAY, PANEL	80009	334735101
–28	131–0955–00			1	CONN,RCPT,ELEC:BNC,FEMALE	TK1725	G35152BN
–29	214–4271–00			1	GROUNDING SPRING:PH BR	80009	214427100
–30	213–0882–00			1	SCREW,TPG,TR:6–32 X 0.437 TAPTITE,PNH,STL	TK0858	ORDER BY DESCRI
–31	407–3791–00			1	BRACKET,CONN:SIDE,RS232	80009	407379100
					ATTACHING PARTS		
–32	211–0468–00			1	SCREW,LOCK ASSY:4–40 X 7.9MM L,HEX W/4–40	80009	211046800
					END ATTACHING PARTS		
–33	334–7713–00			1	LABEL:READOUT ADJUSTMENT	80009	334771300
					END ATTACHING PARTS		
–34	337–3586–00			1	SHIELD,ELEC:BATTERY	80009	337358600

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
4 –							
					STANDARD ACCESSORIES		
	070–7233–00			1	MANUAL,TECH:OPERATORS,2211	80009	070723300
	070–7235–00			1	MANUAL,TECH:USERS REF GUIDE,2211	80009	070723500
–1	161–0104–00			1	CABLE ASSY,PWR,:3 WIRE,98.0 L,W/RTANG CONN (UNITED KINGDOM ONLY)	TK1372	MC6 -3 CG86
	161–0230–01			1	CABLE ASSY,PWR,:3,18 AWG,92.0 L (USA ONLY)	TK1372	ORDER BY DESCRI
–2	343–0003–00			1	CLAMP,LOOP:0.25 ID,PLASTIC	06915	E4 CLEAR ROUND
–3	213–0882–00			1	SCREW,TPG,TR:6–32 X 0.437 TAPTITE,PNH,STL	TK0858	ORDER BY DESCRI
–4	210–0803–00			1	WASHER,FLAT:0.15 ID X 0.375 OD X 0.032,STL	12327	ORDER BY DESCRI
					OPTIONAL ACCESSORIES		
	020–0859–00			1	COMPONENT KIT:EUROPEAN	80009	020085900
	200–2265–00			1	.CAP,FUSEHOLDER:5 X 20MM FUSES	S3629	FEK 031.1663
–5	161–0104–06			1	.CABLE ASSY,PWR,:3 X 0.75MM SQ,220V,98.0 L (OPTION A1 ONLY)	S3109	VIIGSOPO–HO5VVF
	020–0860–00			1	COMPONENT KIT:UNITED KINGDOM	80009	020086000
	200–2265–00			1	.CAP,FUSEHOLDER:5 X 20MM FUSES	S3629	FEK 031.1663
–6	161–0104–07			1	.CABLE ASSY,PWR,:3 X 0.75MM SQ,240V,98.0 L (OPTION A2 ONLY)	S3109	ORDER BY DESCRI
	020–0861–00			1	COMPONENT KIT:AUSTRALIAN	80009	020086100
	200–2265–00			1	.CAP,FUSEHOLDER:5 X 20MM FUSES	S3629	FEK 031.1663
–7	161–0104–05			1	.CABLE ASSY,PWR,:3,18 AWG,240V,98.0 L (OPTION A3 ONLY)	S3109	SAA/3–OD3CCFC3X
	020–0862–00			1	COMPONENT KIT:NORTH AMERICAN	80009	020086200
	200–2265–00			1	.CAP,FUSEHOLDER:5 X 20MM FUSES	S3629	FEK 031.1663
–8	161–0104–08			1	.CABLE ASSY,PWR,:3,18 AWG,240V,98.0 L (OPTION A4 ONLY)	70903	ORDER BY DESCRI
	020–0863–00			1	COMPONENT KIT:SWISS	80009	020086300
	200–2265–00			1	.CAP,FUSEHOLDER:5 X 20MM FUSES	S3629	FEK 031.1663
–9	161–0167–00			1	.CABLE ASSY,PWR,:3.0 X 0.75,6A,240V,2.5M L (OPTION A5 ONLY)	S3109	ORDER BY DESCRI
	016–0180–00			1	VISOR,CRT:FOLDING	TK2165	ORDER BY DESCRI
	016–0566–00			1	VISOR,CRT	TK2165	ORDER BY DESCRI
	016–0592–00			1	VISOR,CRT	TK2165	ORDER BY DESCRI
	016–0677–02			1	POUCH,ACCESSORY:W/PLATE	0JRZ2	016–0677–02
	016–0785–00			1	ACCESSORY KIT:MOUNTING	80009	016078500
	016–0792–01			1	CASE,CARRYING:24.5 X 16.5 X 11.5	34416	2416BE11
	016–0819–02			1	ADAPTER,RACK:RACKMOUNT	80009	016081902
	020–1514–00			1	ACCESSORY KIT:POUCH AND COVER	80009	020151400
	067–1373–00			1	FIXTURE,CAL:VERTICAL DAC	80009	067137300
	070–7234–00			1	MANUAL,TECH:SERVICE,2211	80009	070723400
	200–3397–00			1	COVER,SCOPE:FRONT	TK2165	ORDER BY DESCRI
	337–2775–01			1	SHLD,IMPLOSION	TK2165	ORDER BY DESCRI

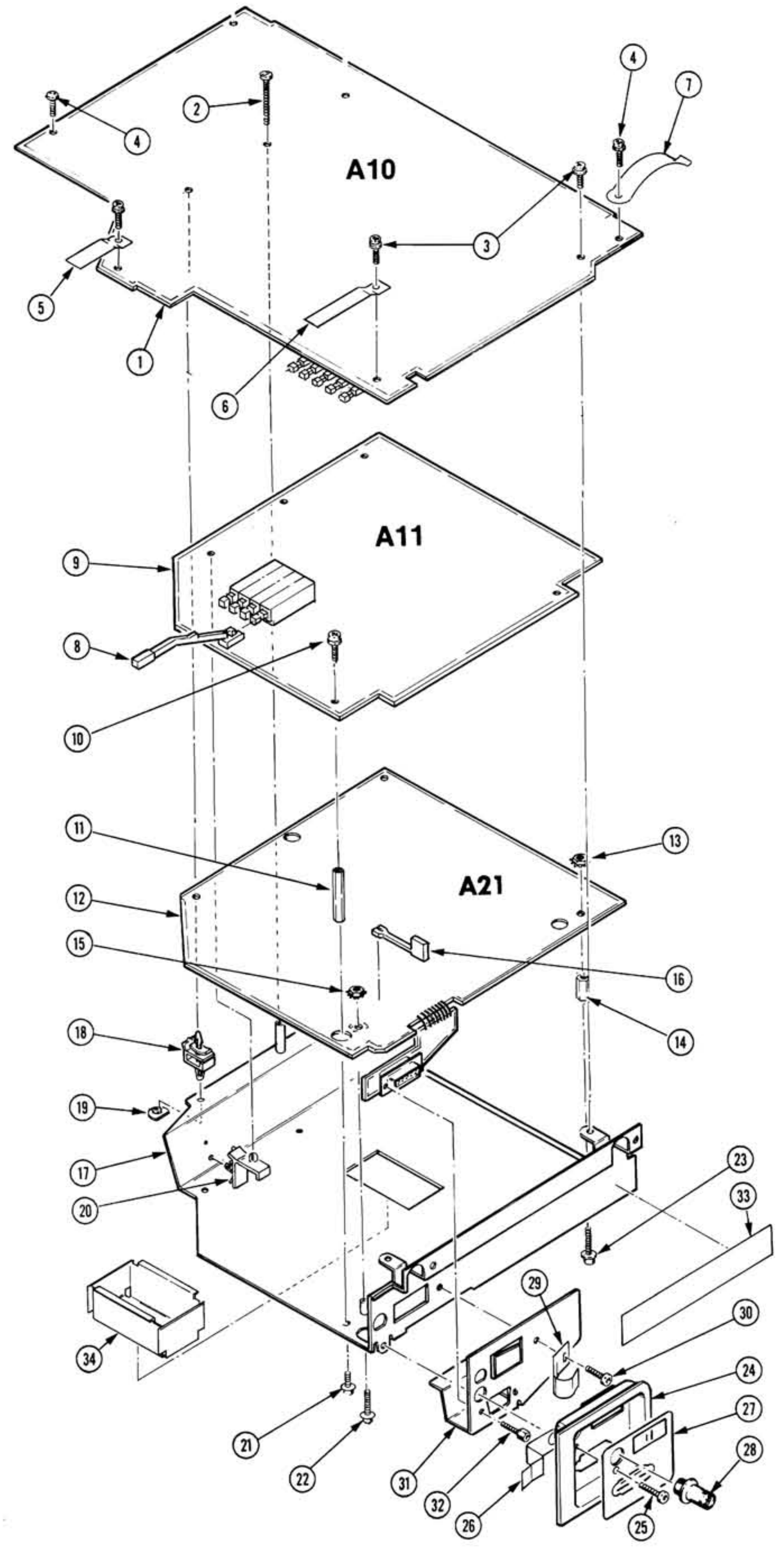
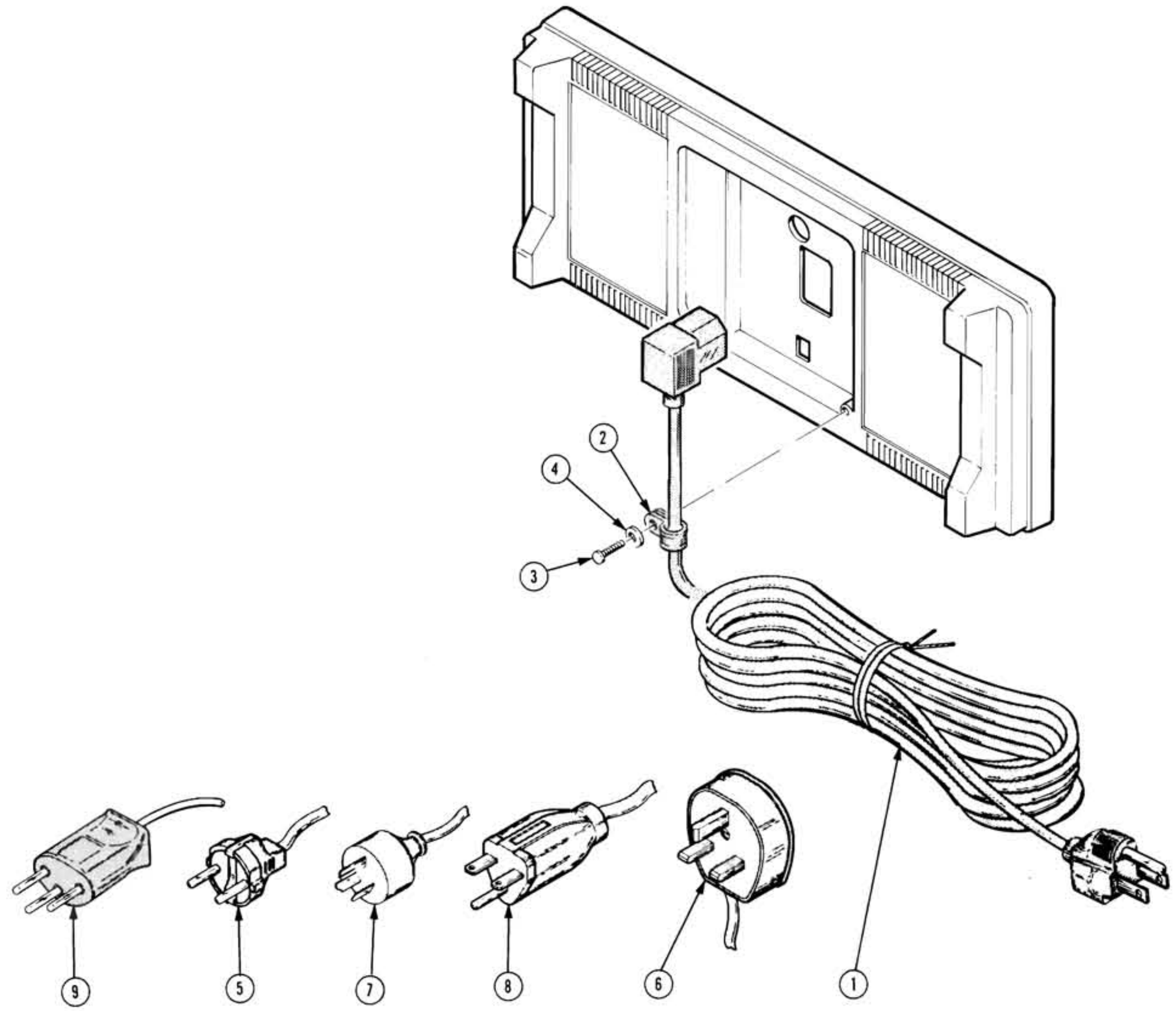


FIG. 3 CIRCUIT BOARDS

FIG. 4 ACCESSORIES



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.

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COMMITTED TO EXCELLENCE

MANUAL CHANGE INFORMATION

Date: 4-25-91 Change Reference: M70958

Product: 2211 SERVICE MANUAL Manual Part Number: 070-7234-00

DESCRIPTION Product Group 41

EFFECTIVE ALL SERIAL NUMBERS

REPLACEABLE MECHANICAL PARTS LIST CHANGES

Fig & Index No.	Part No.	Qty	NAME & DESCRIPTION
CHANGE TO:			
3-17	337-3538-02	1	SHIELD, ELEC
ADD:			
3-17.1	129-1281-01	1	SPACER, POST: 6-32 X 39.85, THD BOTH ENDS BRASS, HEX

This Tek 2211 was modified to properly operate a Seiko DPU-411 thermal printer. The modification occured in the EPROM of the serial interface board. The portion of the printer setup commands:

```
        1Bh 43h 00h 0Bh     (set page length to 11 inches)
was replaced with:
        1Bh 41h 07h         (set line advance to 7 dots)
```

Appropriate data bytes were changed and several NOPs were added in place of the code to send the deleted byte.