

2210

DIGITAL STORAGE OSCILLOSCOPE SERVICE

Tektronix
COMMITTED TO EXCELLENCE

Tillhör
TEKTRONIX AB
Service
08/83 00 80

2210 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*

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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., London

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



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 unless it has been specifically certified for such operation.

Do Not Remove Covers or Panels

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

SERVICING SAFETY SUMMARY

FOR QUALIFIED SERVICE PERSONNEL ONLY

Refer also to the preceding Operators Safety Summary

Do Not Service Alone

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

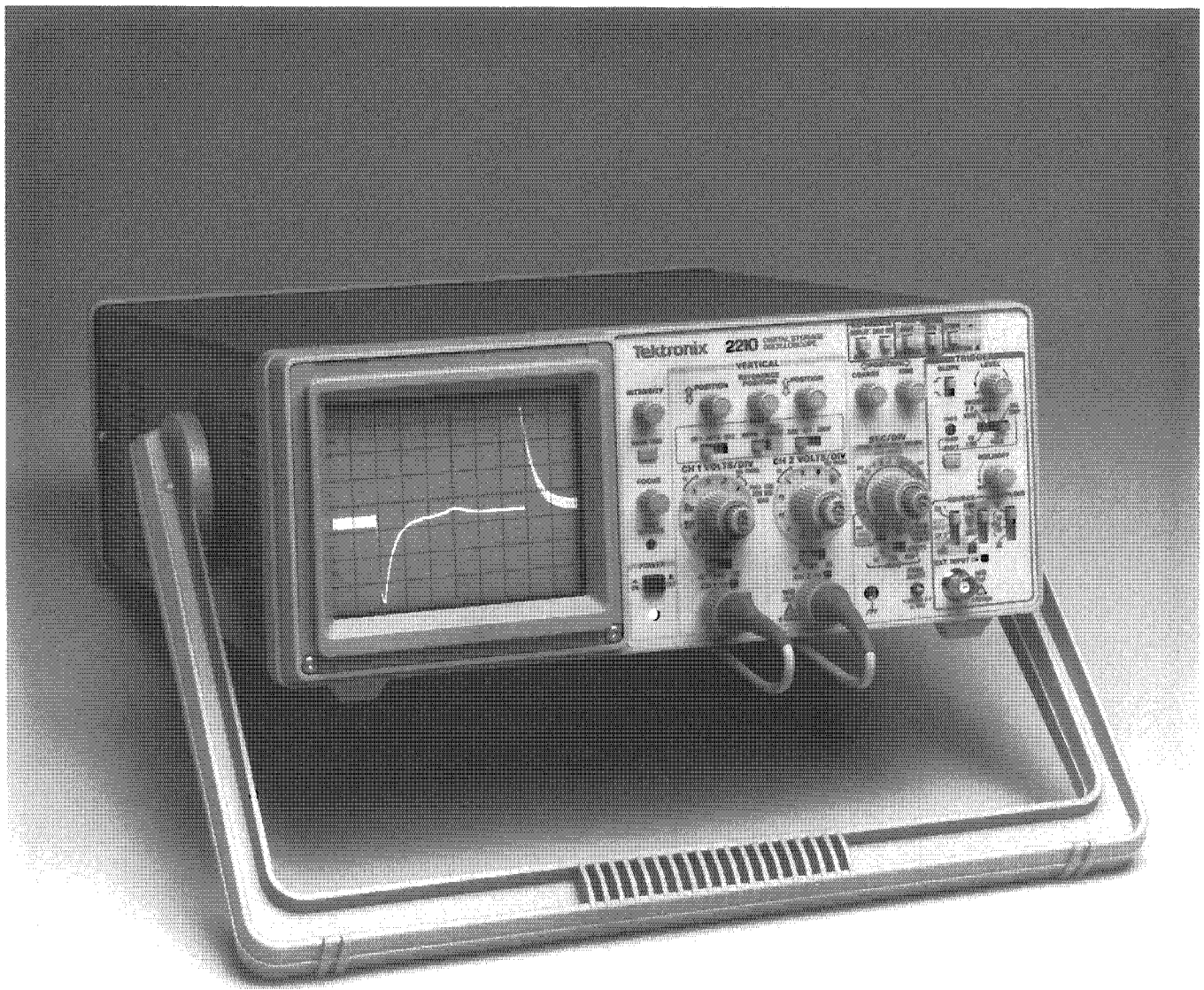
Use Care When Servicing With Power On

Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections 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 250 volts 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.



6848-01

The 2210 Oscilloscope.

SPECIFICATION

INTRODUCTION

The TEKTRONIX 2210 is a combination nonstorage 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.

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 μ V 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.

STORE. The vertical channel display modes are again CH 1, CH 2, and BOTH. With Vertical MODE set to BOTH, 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.

Horizontal

NON-STORE. The horizontal deflection system has calibrated sweep speeds from 0.5 s to 0.05 μ s 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. With X50 magnification, the fastest

sweep time is decreased to 5 ns per division. At SEC/DIV settings of 0.2 μ s, 0.1 μ s, and 0.05 μ s per divisions, X50 magnified displays are not calibrated.

STORE. In STORE mode, the normal calibrated sweep speeds are 0.5 s to 20 μ s per division. At sweep speeds of 20 μ s to 50 ms per division, the digitized display is updated as a full RECORD where all the waveform data points are replaced at once when the acquisition is triggered. At STORE mode sweep speeds of 0.1 s to 0.5 s per division, the display is updated in ROLL mode. In ROLL mode, the waveform is continually 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 in ROLL mode, then the acquisition stops. If the single sweep is untriggered, the ROLL mode acquisition continues. At sweep speeds of 10 ms per division and slower, the STORE mode X100 SEC/DIV multiplier may be used to slow down the ROLL sweep speeds to 1 s to 50 s per division. The STORE mode X100 SEC/DIV multiplier is turned on by rotating the Variable SEC/DIV knob out of the CAL detent position.

Storage Sampling

The maximum sampling rate (digitizing speed) is 20 megasamples per second. A waveform record has 4095 data points (4 Kbytes) per channel for single-channel and dual-channel acquisitions. Waveform acquisition is the digitizing and storing of the 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.

ACCESSORIES

The instrument is shipped with the following accessories—operator's manual, user reference guide, two probe kits, a power cord, and a power-cord clamp. Part numbers for these standard accessories, as well as for other optional accessories are found in Section 7, Options and Accessories. These new probes are built with a sturdy tip that is also replaceable. Compensation is accomplished through a closeable window on the probe body.

FOR MORE INFORMATION

Should you need additional information about your 2210 Oscilloscope or about other Tektronix products, contact the nearest Tektronix Sales Office or Distributor, or 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 RECALIBRATION 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 requirements for the 2210 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 μ V per division in X10 Vertical Mag.
DC Accuracy	
X1	$\pm 3\%$
X10 MAG.	$\pm 5\%$ For 5 mV per division to 5 V per division the gain is set with the VOLTS/DIV switch at 5 mV per division. (X10 Vertical Magnify gain set in 500 μ V setting.)
Storage Acquisition	
Vertical Resolution	8-bits, 25 levels per division. ^a
Dynamic Range	10.24 divisions. ^a
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 (calculated). ^a
0°C to +40°C	
5 mV per division to 5 V per division	8.8 ns or less (calculated). ^a Rise time is calculated from this formula: $\text{Rise Time} = \frac{0.35}{\text{Bandwidth } (-3 \text{ dB})}$
Step Response (STORE Mode)	
Useful Storage Rise Time	$\frac{\text{SEC/DIV} \times 1.6}{100} \text{ s.}^a$ Rise time is limited to 35 ns minimum.

^a Performance requirement not checked in manual.

Table 1-1 (cont)
Electrical Characteristics

Characteristics	Performance Requirements
VERTICAL DEFLECTION SYSTEM (cont)	
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.
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. ^a Measured with a vertically centered 6-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.
Vertical X10 Magnified Bandwidth (-3 dB)	Dc to at least 5 MHz.
AC Coupled Lower Cutoff Frequency	10 Hz or less at -3 dB. ^a
Useful Storage Performance	Useful storage performance is limited to the frequency where there are 10 samples per sine-wave signal period at the maximum sampling rate. This yields a maximum amplitude uncertainty of 5%. (Max sampling rate is 20 MHz.) Accuracy at useful storage performance limit is measured with respect to a 6-division, 50-kHz reference sine wave.
20 μs per division to 50 s per division	$\frac{40}{\text{SEC/DIV}}$ Hz. ^a
EXT CLOCK (up to 10 MHz)	$\frac{\text{EXT}}{10}$ Hz. ^a

^a Performance requirement not checked in manual.

Table 1-1(cont)
Electrical Characteristics

Characteristics	Performance Requirements
VERTICAL DEFLECTION SYSTEM (cont)	
NON-STORE CHOP Mode Switching Rate	500 kHz $\pm 30\%$. ^a
A/D Converter Linearity	Monotonic with no missing codes. ^a
Input Characteristics	
Resistance	1 M Ω $\pm 2\%$. ^a
Capacitance	25 pF ± 2.0 pF. ^a
Maximum Safe Input Voltage DC and AC coupled	400 V (dc + peak ac) or 800 V ac p-p at 10 kHz or less. ^a See Figure 1-1 for the maximum input voltage versus frequency derating curve.
Common-Mode Rejection Ratio (CMRR)	Checked at 5 mV per division for common-mode signals of 6 divisions or less with the Variable VOLTS/DIV control adjusted for the best CMRR at 50 kHz.
NON-STORE	At least 10:1 at 20 MHz.
STORE	At least 10:1 at 10 MHz.
Vertical X10 Magnified	At least 10:1 at 1 MHz; checked at 500 μ V/div setting. ^a
Trace Shift with VOLTS/DIV Switch Rotation	0.25 divisions or less; Variable VOLTS/DIV control in CAL detent. ^a
Trace Shift as Variable VOLTS/ DIV Control is Rotated	1 division or less. ^a
Trace Shift with INVERT	1.5 division or less. ^a
Trace Shift with X10 MAG.	2.0 division or less. ^a
NON-STORE Channel Isolation	Greater than 100:1 at 10 MHz.
STORE Channel Isolation	Greater than 100:1 at 10 MHz.

^a Performance requirement not checked in manual.

Table 1-1 (cont)
Electrical Characteristics

Characteristics	Performance Requirements	
TRIGGERING SYSTEM		
Trigger Sensitivity		
P-P AUTO and NORM		
Internal	5 MHz	50 MHz ^a
External	0.35 div	1.0 div
	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 ^a	External ^a
	0.35 div	40 mV p-p
TV FIELD	1 division of composite sync. ^a	
P-P AUTO Lowest Usable Frequency	20 Hz with 1 division internal or 100 mV p-p external.	
EXT INPUT		
Maximum Input Voltage	400 V (dc + peak ac) or 800 Vac p-p at 10 kHz or less. ^a See Figure 1-1 for the maximum input voltage versus frequency derating curve.	
Input Resistance	1 MΩ ±10%. ^a	
Input Capacitance	25 pF ± 2.5 pF. ^a	
LEVEL Control Range (NORM Trigger Mode)		
Internal Trigger	May be set to any voltage level of the trace that can be displayed. ^a	
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 eight, with the SEC/DIV switch set to 1 ms. ^a	
AC Coupled Lower Cutoff Frequency		
Internal Source	10 Hz or less at -3 dB. ^a	
External Source	20 Hz or less at -3 dB. ^a	
LF REJ Lower 3 dB Point	30 kHz ± 25%. ^a	
HF REJ Upper 3 dB Point	30 kHz ± 25%. ^a	
DC Coupled Bandwidth	Dc to full vertical bandwidth. ^a	
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.	

^a Performance requirement not checked in manual.

Table 1-1 (cont)
Electrical Characteristics

Characteristics	Performance Requirements		
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.		
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 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 unmagnified sweeps.		
Horizontal POSITION Control Range	Start of the 10th division will position past the center vertical graticule line in X1. (100th division in X10 magnified 500th division in X50).		
NON-STORE/STORE Sweep Linearity	X1	X10	X50
	± 5%	±8%	± 9%
	Linearity measured over any 2 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. ^a		
External Clock Input Frequency			
RECORD	Dc to 10 MHz.		
ROLL	Dc to 4 kHz.		
Digital Sample Rate	Equal to the input frequency. ^a		
Duty Cycle	LO (minimum) ^a	HI (minimum) ^a	
RECORD	50 ns	50 ns	
ROLL	50 μs	125 ns	

^a Performance requirement not checked in manual.

Table 1-1 (cont)
Electrical Characteristics

Characteristics	Performance Requirements		
HORIZONTAL DEFLECTION SYSTEM (cont)			
External Clock (cont)			
Logic Thresholds			
LOW	0.7 V. ^a		
HIGH	2.1 V. ^a		
Maximum Safe Input Voltage	25 V (dc + peak ac) or 25 V p-p ac at 100 kHz or less. ^a See Figure 1-2 for the maximum input voltage versus frequency derating curve.		
Input Resistance	1 MΩ ±10%. ^a		
Input Capacitance	25 pF ±2.5 pF. ^a		
STORE Mode Resolution			
Acquisition Record Length	4096 data points. ^a		
Waveform Acquisition Display	4095 data points (400 data points per division across the graticule area). ^a		
Variable SEC/DIV Control Range			
NON-STORE	Continuously variable between calibrated settings of the SEC/DIV switch. Slows the sweep speed by at least a factor of 2.5 times from the calibrated SEC/DIV switch setting.		
STORE	At SEC/DIV switch settings between 0.5 s and 10 ms, when the Variable SEC/DIV control is rotated out of the CAL detent the SEC/DIV setting is multiplied by 100, and the STORE display mode 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.		
	Variable Position	Display Mode	Frequency Range
	CAL	RECORD	Dc to 10 MHz
	UNCAL	ROLL	Dc to 4 kHz
Displayed Trace Length	Greater than 10 divisions.		
Registration between Magnified and Unmagnified Traces	Within 0.2 division or less with magnified trace aligned to the center vertical graticule line. ^a		

^a Performance requirement not checked in manual.

Table 1-1 (cont)
Electrical Characteristics

Characteristics	Performance Requirements
DIGITAL STORAGE DISPLAY	
Vertical Resolution	8-bit (1 part in 256). Display waveforms calibrated for 25 points per division.
Position Registration NON-STORE to STORE	Within ± 0.5 division at graticule center for VOLTS/DIV switch settings from 5 mV to 5 V.
REFERENCE POSITION Control Range	At least +3 divisions.
Horizontal Digital Sweep	Calibrated to 400 points per division. ^a
Expansion Range	1, 10, or 50 times; set by the X1-X10-X50 MAG switch. ^a
X-Y OPERATION (X1 MAG AND NON-STORE ONLY)	
Deflection Factors	Same as vertical deflection system with the Variable VOLTS/DIV controls in the CAL detent positions.
Accuracy	Measured with a dc-coupled, 5-division reference signal.
X-Axis	Within $\pm 5\%$.
Y-Axis	Same as vertical deflection system. ^a
Bandwidth (-3 dB)	Measured with a 5-division reference signal.
X-Axis	Dc to at least 2 MHz.
Y-Axis	Same as vertical deflection system. ^a
NON-STORE Phase Difference Between X-Axis and Y-Axis Amplifiers	$\pm 3^\circ$ from dc to 150 kHz. ^a Vertical input-coupling switches set to DC.
PROBE ADJUST	
Output Voltage on PROBE ADJUST Jack	0.5 V $\pm 5\%$.
Repetition Rate	1 kHz $\pm 20\%$. ^a

^a Performance requirement not checked in manual.

Table 1-1 (cont)
Electrical Characteristics

Characteristics	Performance Requirements
Z-AXIS	
Sensitivity (NON-STORE Only)	5 V causes noticeable modulation. Positive-going input decreases intensity.
Usable Frequency Range	Usable frequency range is dc to 5 MHz. ^a
Maximum Safe Input Voltage	Same as External Trigger. ^a
POWER SUPPLY	
Line Voltage Ranges	95 Vac to 128 Vac and 185 Vac to 250 Vac.
Line Frequency	48 Hz to 440 Hz.
Maximum Power Consumption	70 watts (80 VA).
Line Fuse	
115 V operation	1 A, slow-blow.
230 V operation	0.5 A, slow-blow.
CRT DISPLAY	
Display Area	8 x 10 cm.
Standard Phosphor	P31.
Nominal Accelerating Voltage	12.6 kV.

^a Performance requirement not checked in manual.

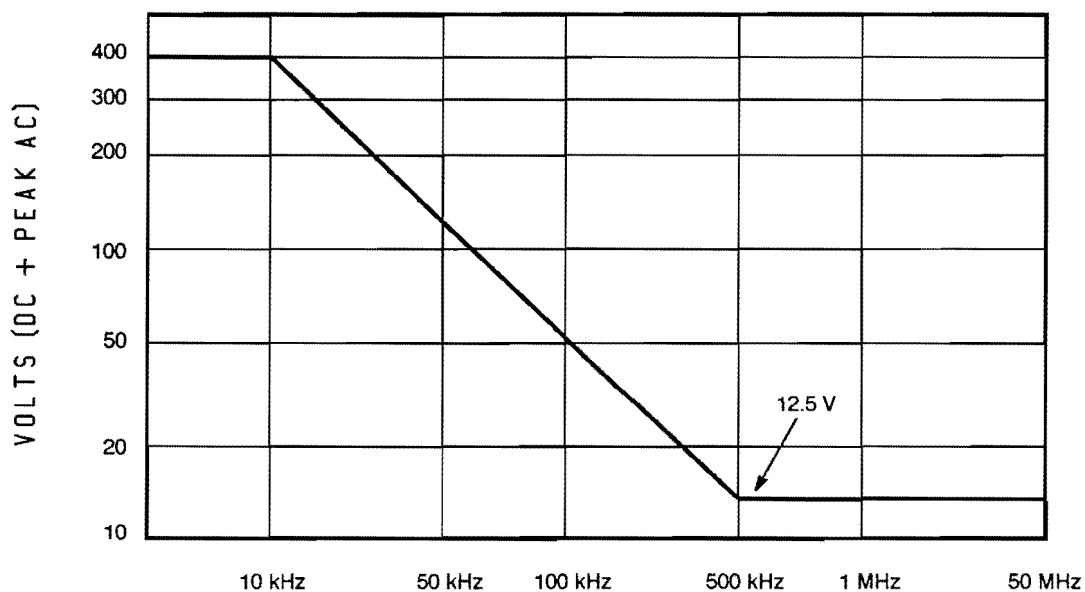
Table 1-2
Environmental Specification

Characteristics	Performance Requirements
Temperature	
Operating	0°C to +40°C (+32°F to +104°F). ^a
Nonoperating	-55°C to +75°C (-67°F to +167°F).^a Tested to MIL-T-28800C, paragraphs 4.5.5.1.3 and 4.5.5.1.4 (0°C operating test) except that in paragraphs 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 4,570 meters (15,000 feet). Maximum operating temperature decreases 1°C per 1000 feet above 5,000 feet. ^a
Nonoperating	To 15,240 meters (50,000 feet). ^a
Humidity	
Operating and Nonoperating	5 cycles (120 hours) referenced to MIL-T-28800C paragraphs 4.5.5.1.2.2 for type III, Class 5 instruments. Operating and nonoperating at 95% -5% to +0% relative humidity. Operating, +30°C to +40°C; nonoperating, +30°C to +60°C. ^a
EMI	Meets radiated and conducted emission requirements per VDE 0871, Class B. Meets FCC section 15, sub-part J, class A. ^a
Vibration	
Operating	15 minutes along each of 3 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 1-minute sweeps. Hold for 10 minutes at 55 Hz in each of the 3 major axes. All major resonances must be above 55 Hz. ^a
Shock	
Operating and Nonoperating	30 g, half-sine, 11-ms duration, 3 shocks per axis each direction, for a total of 18 shocks. ^a

^a Performance requirement not checked in manual.

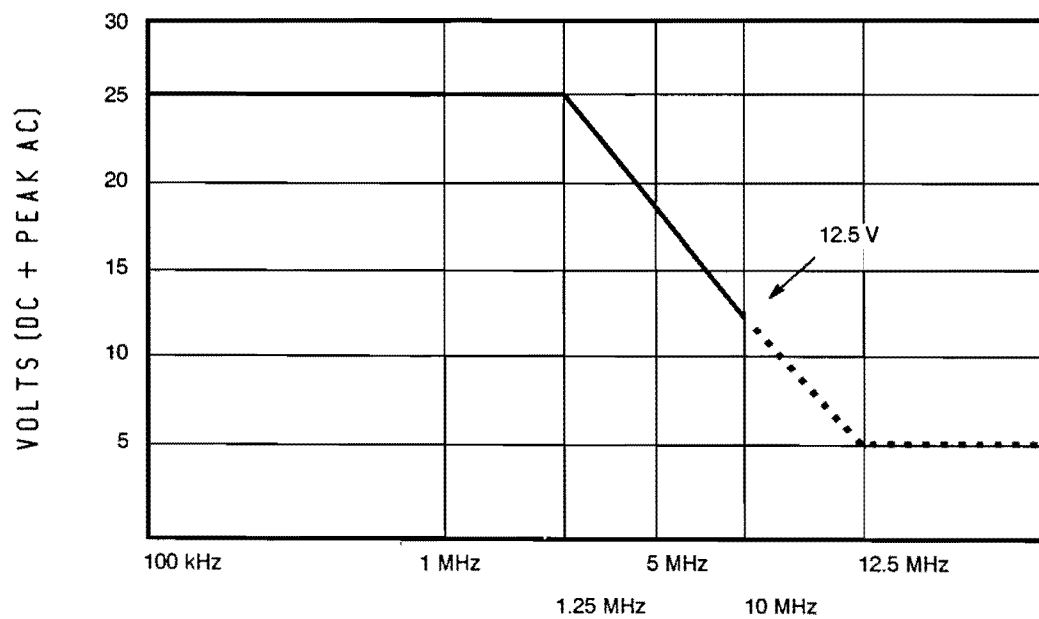
Table 1-3
Mechanical Specification

Characteristics	Description
Weight	
With Power Cord	7.62 kg (16.8 lb).
Domestic Shipping Weight	9.5 kg (20.9 lb).
Height	138 mm (5.4 in).
Width	
With Handle	385 mm (15.17 in).
Without Handle	327 mm (12.9 in).
Depth	443 mm (17.42 in).
With Handle Extended	516 mm (20.31 in).



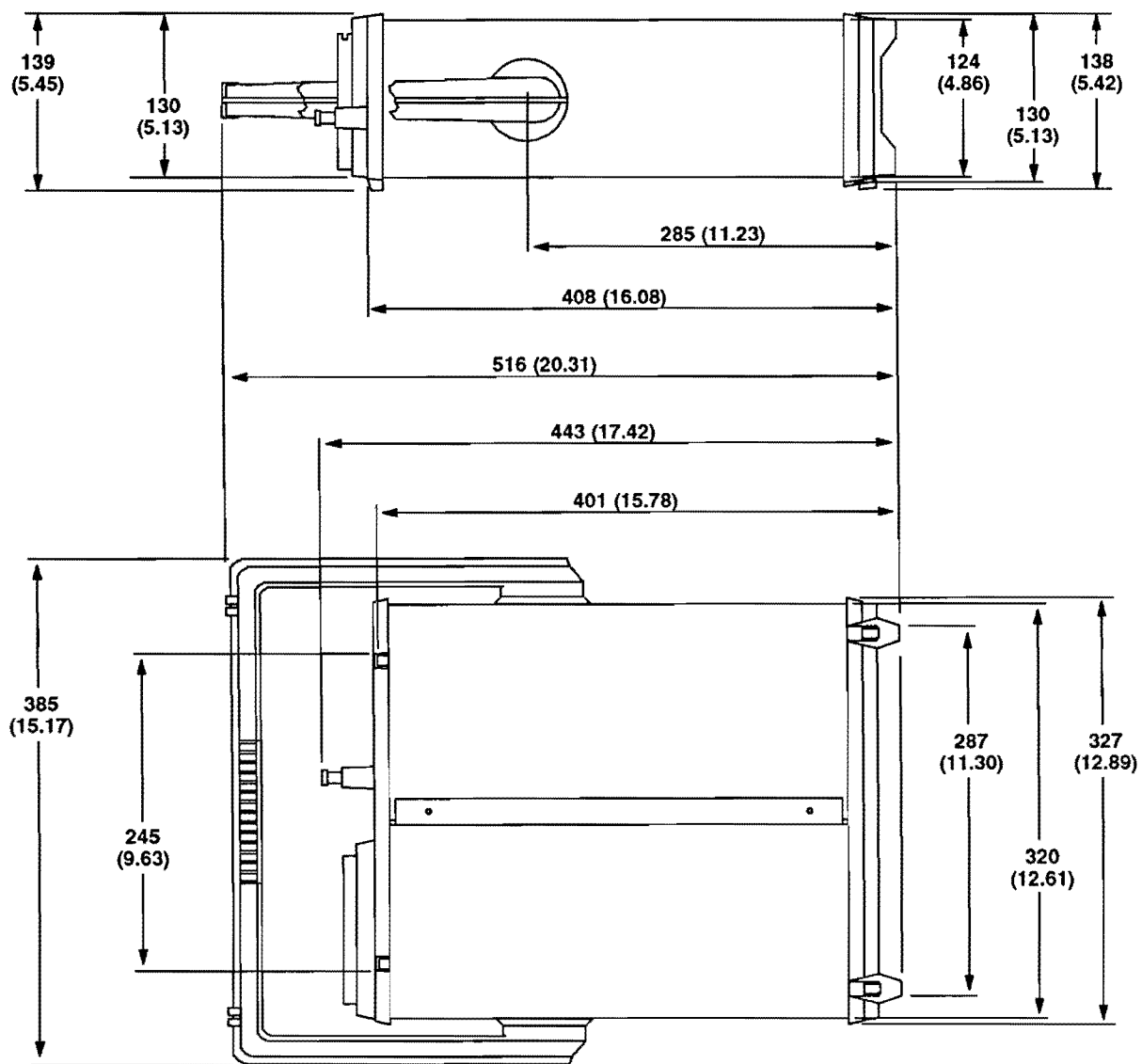
k6848-02

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.



k6848-03

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



Dimensions are in mm (inches)

k6848-04

Figure 1-3. Instrument dimensional drawing.

OPERATING INSTRUCTIONS

This section is divided into four subsections. The first subsection, Preparation for Use, provides instructions for the user to follow before turning the instrument on, especially for the first time. Subsection two; Controls, Connectors, and Indicators; provides details on the operation of the front-panel controls. Subsection three,

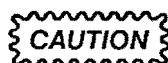
Operating Considerations, provides the user with some of the more general information on measurement techniques. The last subsection, Operators Checks and Adjustments, provides simple checks and adjustments to be made on a routine basis by the user.

PREPARATION FOR USE

SAFETY

This section tells how to prepare for and to proceed with the initial start-up of the TEKTRONIX 2210 Oscilloscope.

Refer to the Safety Summary 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 a power source, read both this section and the Operator's Safety Summary at the beginning of this manual.



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.

LINE VOLTAGE SELECTION

The oscilloscope operates from either a 115-V or a 230-V nominal ac-power line with a 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.

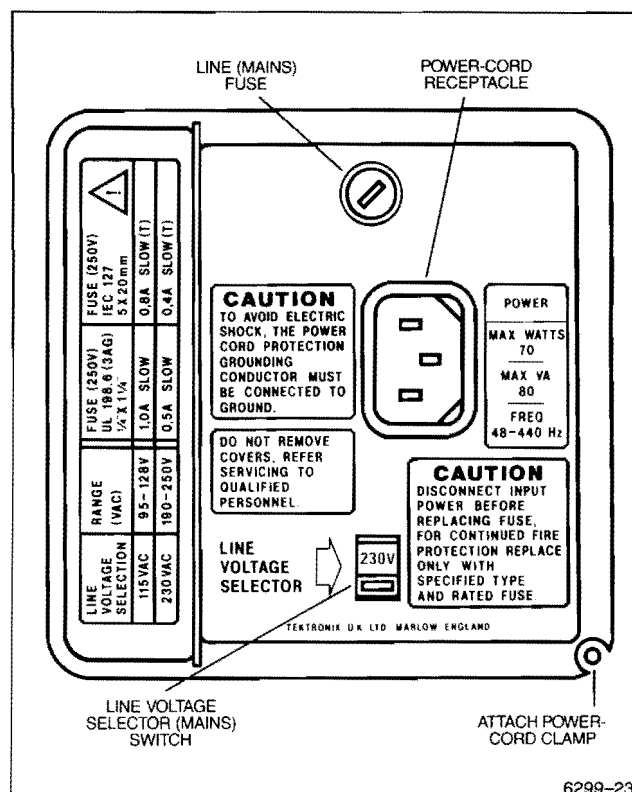


Figure 2-1. Voltage Selector switch, fuse, and power-cord receptacle.

To convert the 2210 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 2210 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 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.

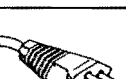
5. Put the fuse (or replacement fuse) back in the fuse holder cap.
6. Reinstall the fuse and cap in the fuse holder by pressing in and giving a slight clockwise rotation of the cap.

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—Schweizerischer Elektrotechnischer Verein
UL—Underwriters Laboratories Inc.

Figure 2-2. Optional power cords.

INSTRUMENT COOLING

The 2210 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 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.

See Figure 2-3 for location of items 1 through 7.

POWER AND DISPLAY

- ① **INTERNAL GRATICULE**—Eliminates parallax viewing error 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 all displayed waveforms.
- ③ **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.
- ④ **FOCUS Control**—Adjusts for optimum display definition. Once set, proper focusing is maintained over a wide range of display intensity.
- ⑤ **TRACE ROTATION Control**—Permits alignment of the trace with the horizontal graticule line. This control is a screwdriver adjustment that, once set, should require little attention during normal operation.
- ⑥ **POWER Switch**—Turns instrument power on or off.
- ⑦ **Power On Indicator**—Lights up while the instrument is operating.

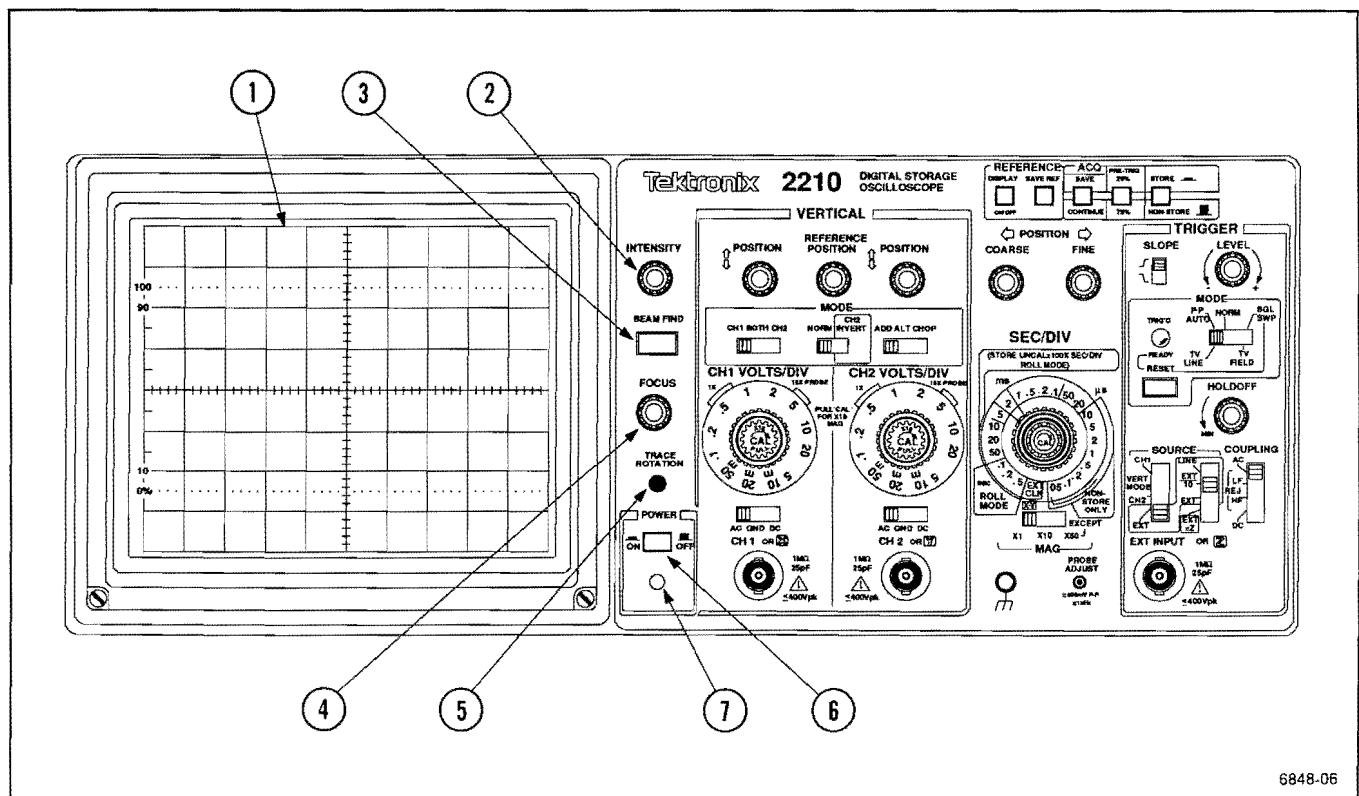


Figure 2-3. Power and Display controls and power-on indicator.

VERTICAL

See Figure 2-4 for the location of items 8 through 16.

- ⑧ **Channel 1 Vertical POSITION Control**—Controls the vertical display position of the CH 1 signal. This control does not function in the NON-STORE, X-Y mode.

- ⑨ **Channel 2 Vertical POSITION Control**—Controls the vertical display position of the CH 2 signal. This control also positions the NON-STORE, X-Y mode display vertically.

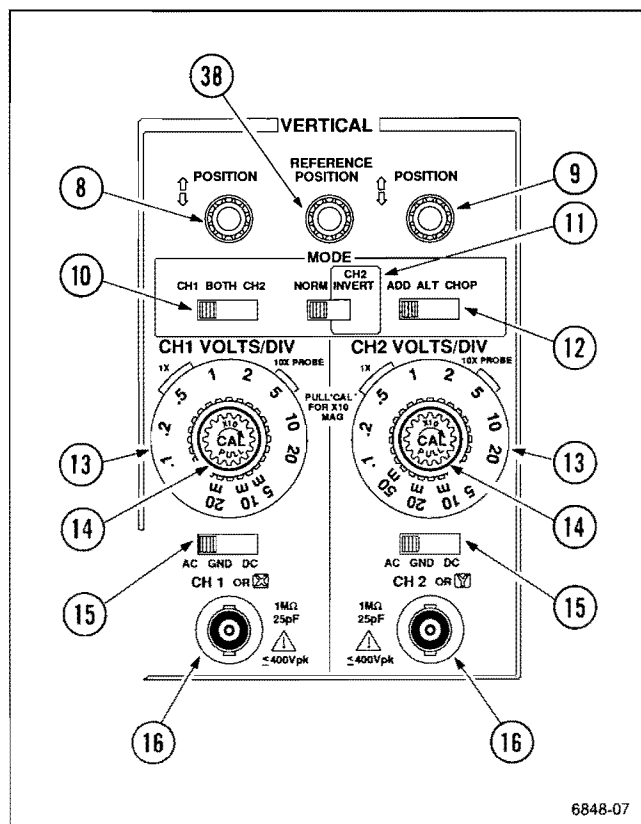


Figure 2-4. Vertical controls and connectors.

- ⑩ **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 CH 1 input signal for display.

BOTH—Selects a combination of CH 1 and CH 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 CH 2 input signal for display.

- ⑪ **NORM/CH 2 INVERT Switch**—Inverts the CH 2 display when in the CH 2 INVERT position. With CH 2 inverted, the oscilloscope may be operated as a differential amplifier when the BOTH-ADD Vertical Mode is selected. In NORM, the CH 2 display and trigger signal are non-inverted.

- ⑫ **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 CH 1 and CH 2 input signals when BOTH is also selected. The difference of the CH 1 and CH 2 input signals is displayed when the CH 2 signal is inverted. In STORE mode ADD, the sum is acquired by CH 1, the record length is 4K.

ALT—Alternately displays the NON-STORE CH 1 and CH 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 and faster.

CHOP—Switches the display between CH 1 and CH 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 triggering is selected. With VERT MODE trigger selected, each channel is acquired alternately.

- ⑬ **VOLTS/DIV Switches**—Select the vertical channel deflection factors from 5 mV to 5 V per division in a 1-2-5 sequence.

1X—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.

10X PROBE—Front-panel marking that indicates the deflection factor set by the VOLTS/DIV switch when a 10X probe is attached to the channel input connector.

NOTE

The 50-volts-per-division position is not marked on the VOLTS/DIV knob, but it is available using a 10X probe at the 1X, 5-V position of the VOLTS/DIV switch.

- 14 Variable VOLTS/DIV Controls**—Provide uncalibrated variable deflection factors between the calibrated settings of the VOLTS/DIV controls and control the Vertical X10 Gain. 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. Pulling the Variable VOLTS/DIV knob out multiplies the vertical gain by X10; it also limits the vertical bandwidth to 5 MHz.

- 15 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.

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.

- 16 CH 1 OR X and CH 2 OR Y Input Connectors**—Provide for application of 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 17 through 23.

- 17 COARSE Horizontal POSITION Control**—Positions all the waveforms horizontally over a one-sweep-length range in X1, X10, or X50 Magnification.
- 18 FINE Horizontal POSITION Control**—Allows for fine horizontal positioning of the waveforms. This control is most useful on horizontally magnified displays.

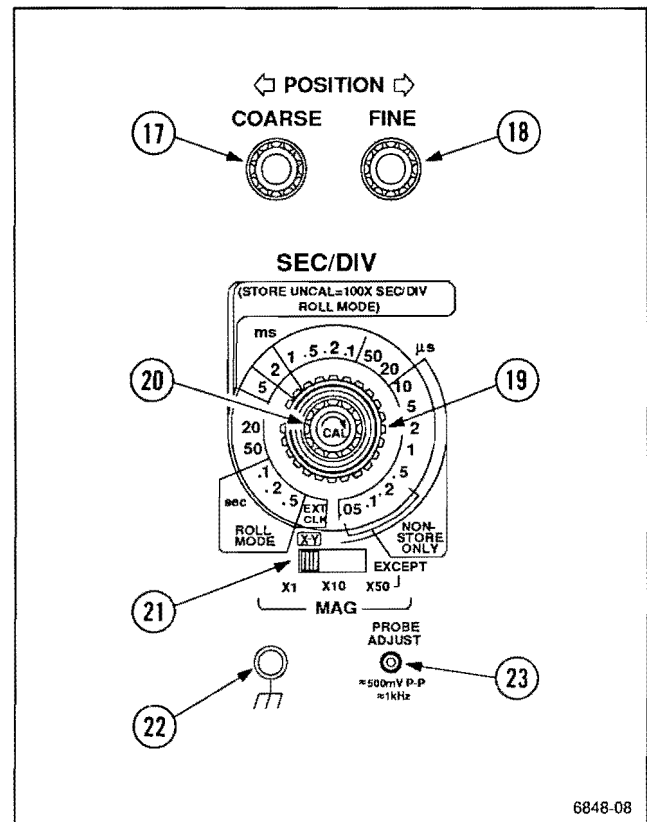


Figure 2-5. Horizontal controls.

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

If a SEC/DIV range above 20 μ s is selected while in STORE mode, the display is flashed at a 2-Hz rate, indicating that an illegal control setting has been selected. The acquisition continues at the 20 μ s/div rate when the display is flashing.

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

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

At SEC/DIV settings of 10 ms and below, when the Variable SEC/DIV control is rotated out of

the CAL position, the selected SEC/DIV setting is multiplied by 100, and the display is switched to ROLL mode. Table 2–2 shows the relationship between CAL and UNCAL (100X) SEC/DIV ranges.

In STORE mode, the EXT CLK/X–Y position on the SEC/DIV switch selects external clock. With EXT CLK selected, the digitizing rate is controlled by a signal applied to the EXT CLOCK connector, located on the right-hand side of the instrument.

- 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 counter-clockwise rotation increases the slowest sweep time per division to at least 2 sec.

In STORE mode (10 ms per division to 0.5 s per division), if the Variable control is switched out of the 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, and an external clock frequency of dc to 10 MHz is permitted. Out of the CAL detent, ROLL mode is selected, and an external clock frequency of dc to 4 kHz is permitted.

Table 2–1
Storage Display Modes

SEC/DIV Switch Setting	Display Mode	
	Variable in CAL	Variable in UNCAL
0.05 μ s to 10 μ s	Flashing	Flashing
20 μ s to 5 ms ^a	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
XY (EXTERNAL CLOCK)	RECORD Clock: dc to 10 MHz	ROLL Clock: dc to 4 kHz

^a The Variable SEC/DIV control has no effect in this range.

Table 2-2
Extended SEC/DIV Settings

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.
- 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 the horizontal accuracy of the instrument.

TRIGGER

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

- 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.
- 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.

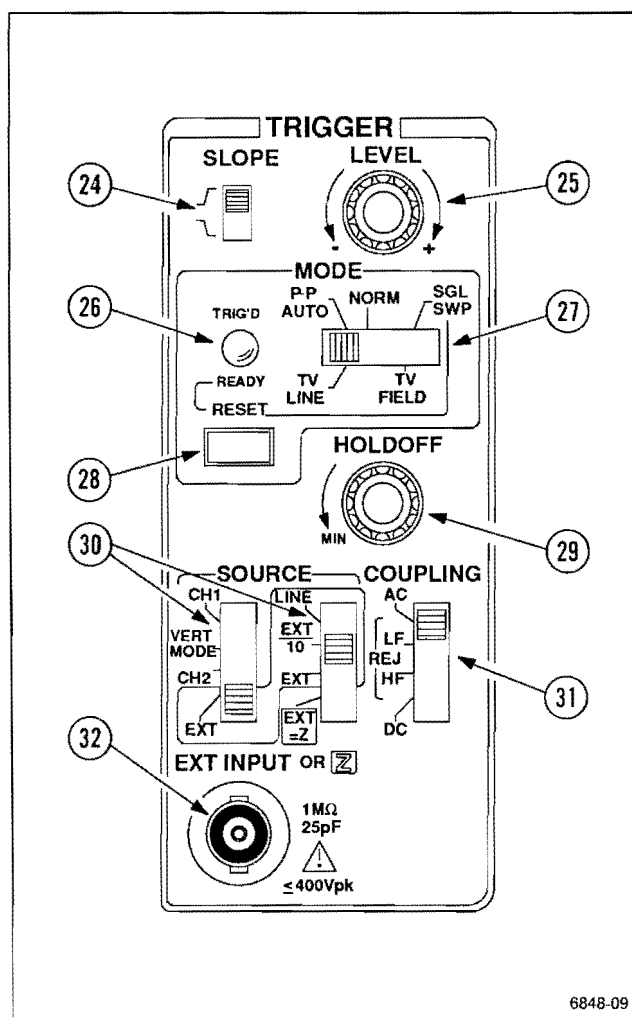


Figure 2-6. Trigger controls, connector, and indicators.

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. In STORE, all the triggered modes (including P-P AUTO when an auto trigger is generated) have the trigger-point indicator displayed as an intensified dot in the waveform RECORD at the 25% or 75% pretrigger point.

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 auto-trigger 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 μ s, 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 obtaining a stable display of low-frequency and low-repetition-rate signals.

In STORE mode, the trigger system is operational only in the RECORD and ROLL SGL SWP modes, (see Table 2-1). In RECORD

mode, the display is updated after the acquisition is complete; the last waveform acquired remains displayed until that time.

In ROLL mode, the trigger signal is ignored for all the Trigger Modes except in SGL SWP Trigger Mode (see Table 2-3). In untriggered 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.

SGL SWP—Selects single sweep operation.

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, the display continues to roll when SGL SWP is selected until the trigger circuit is 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% PRE-TRIG button. In SGL SWP, if BOTH-ALT Vertical Mode is selected along with VERT MODE Trigger Source, the triggered channel behaves as just 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 CH 1 input.

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.

CH 2—Trigger signal is obtained from the CH 2 input. 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.

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.

HF REJECT—Rejects (attenuates) the high-frequency components (above 30 kHz) from the trigger circuit.

LF REJECT—Rejects (attenuates) the low-frequency components (below 30 kHz) from the trigger circuit.

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.

- 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.

- ③④ **PRE-TRIG 25%/75% Switch**—Selects either 25% pretrigger 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. The switch selects 75% pretrigger when out; 25% when pressed in.

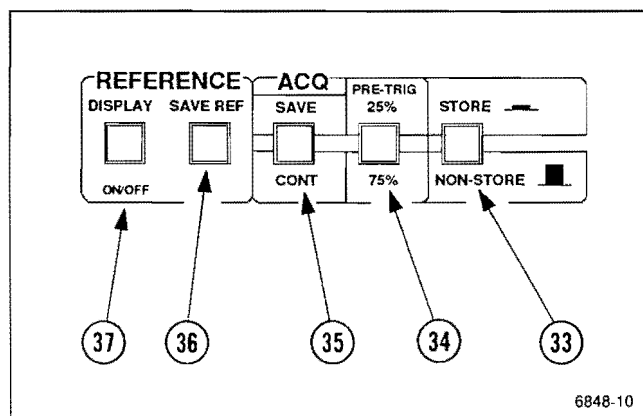


Figure 2-7. Storage controls.

- ③⑤ **ACQ SAVE/CONTINUE Switch**—Stops the display from being updated when pressed in. If the display mode is ROLL (see Table 2-1), the current acquisition is stopped immediately upon pressing the button. Releasing the button causes the acquisition to continue. If the display mode is RECORD (see Table 2-1), 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 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.

- 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 overwritten 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**—Turns the stored reference waveform display on and off when in STORE mode.

See Figure 2-4 (shown previously) for the location of item 38.

- 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 portions 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 downward.

REAR PANEL

See Figure 2-8 for the location of items 39 through 41.

- ③⑨ **Fuse Holder**—Contains the ac-power-source fuse. See the rear panel nomenclature for fuse rating and line voltage range.

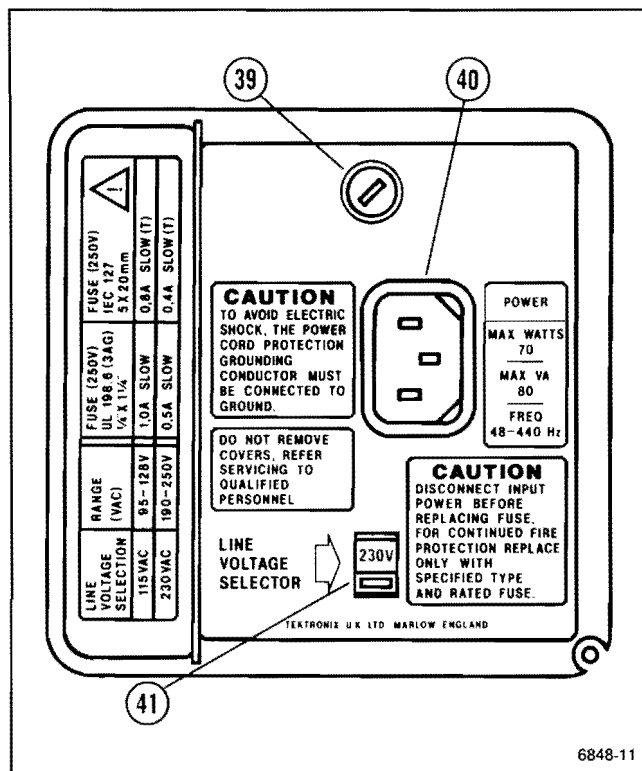


Figure 2-8. Rear Panel.

- ④① **Detachable Power Cord Receptacle**—Provides the connection point for the ac power source to the instrument.
- ④① **LINE VOLTAGE SELECTOR (Mains switch)**—Selects the line voltage range, either 115 V or 230 V.

SIDE PANEL

The standard side panel includes one BNC connector. Refer to Figure 2-9 for the location of item 42.

- ④② **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).

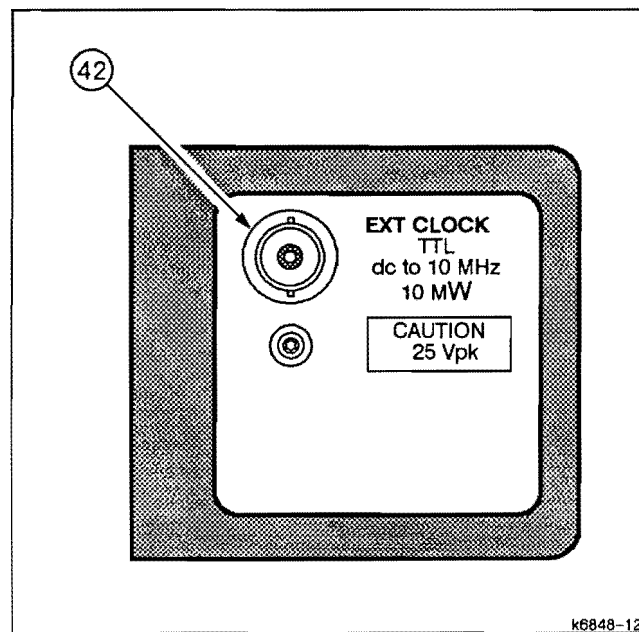


Figure 2-9. Right side panel.

OPERATING CONSIDERATIONS

This part 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 2-10).

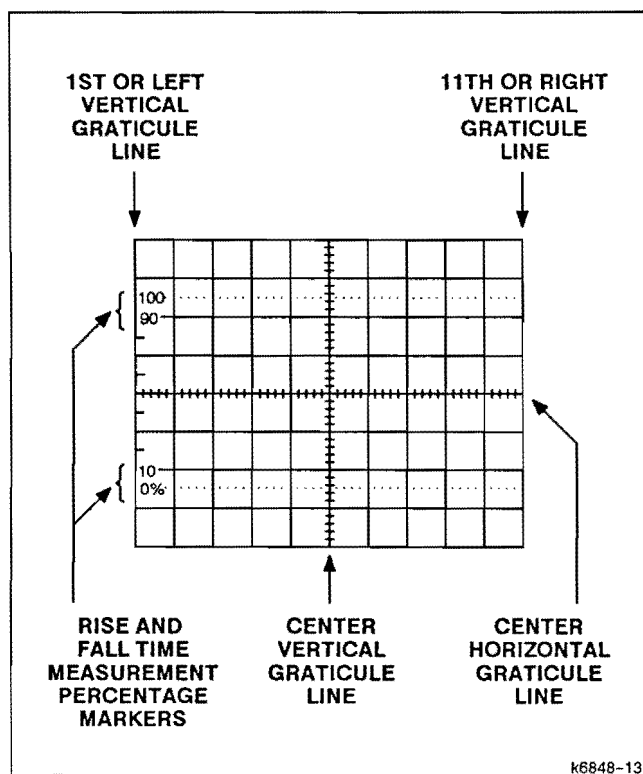


Figure 2-10. Graticule measurement markings.

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.

GROUNDING

The most reliable signal measurements are made when the 2210 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 ($\hbar$) 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.

Before applying power for new equipment checks, refer to Preparation for Use in this manual to prepare the instrument for the initial start-up. Only proceed with these instructions after the power supply has been properly set up for the local line voltage.

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. Then plug the power cord into the ac power outlet.
2. 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 (COARSE and FINE)	Midrange
MAG	X1

Trigger

HOLD OFF	MIN (fully counterclockwise)
SOURCE	VERT MODE
MODE	P-P AUTO
LEVEL	For a stable display (with signal applied)
SLOPE	Positive-going (—)
COUPLING	AC

Storage

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

3. Adjust the Vertical and Horizontal POSITION controls to position the trace within the graticule area.
4. Adjust the INTENSITY and FOCUS controls for the desired display brightness and best focused trace.
5. 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 CH 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 the two 10X probes supplied with the instrument 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 Figure 2-11). 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. (See Figure 2-12 for the location of the compensation adjustment.)
7. Take the CH 1 probe off the PROBE ADJUST terminal.
8. Connect the CH 2 probe to the PROBE ADJUST terminal.

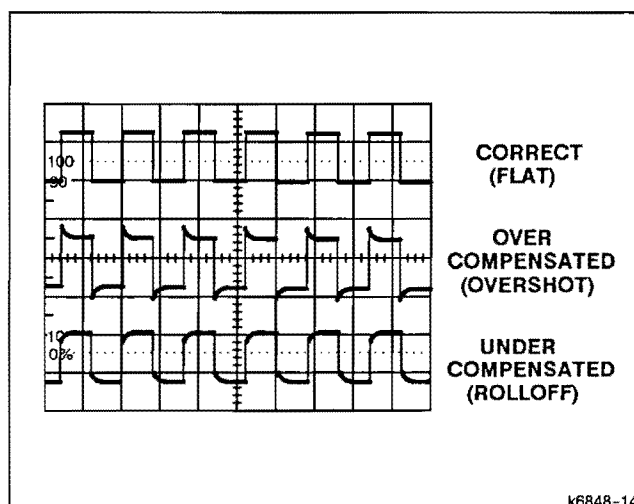


Figure 2-11. Probe compensation.

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 5-1). If compensation is needed, use a small-bladed screwdriver or alignment tool to adjust for a square front corner on the waveform.

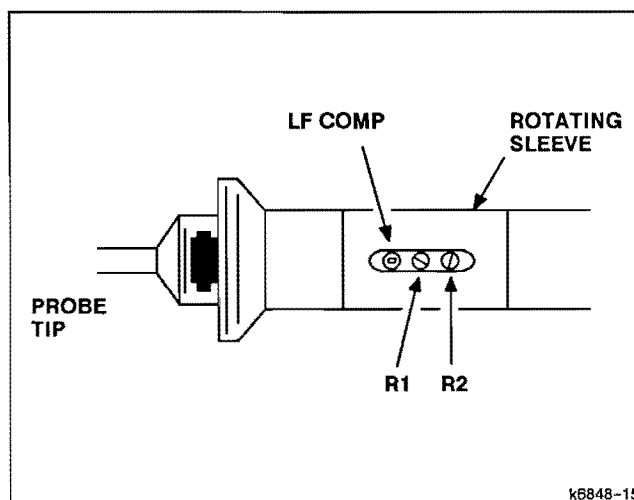


Figure 2-12. Probe compensation locations.

THEORY OF OPERATION

INTRODUCTION

SECTION ORGANIZATION

This section contains a functional description of the 2210 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 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.

NOTE

On the schematic diagrams depicting the analog circuitry portions of the 2210, signals that are asserted LO are indicated by overlining the signal name. The schematic diagrams for the storage circuitry portions of the 2210 indicate signals that are asserted LO by an "L" in parentheses following the signal name.

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 Diagrams, Figures 9-4 and 9-5, 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 circuitry. These portions of the instrument are

described first, with appropriate references to areas that either provide information to or are controlled by the storage circuitry of the oscilloscope. The Storage circuit discussion follows the analog circuitry description.

VERTICAL

Signals to be displayed on the crt (cathode-ray tube) 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 precharge 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 cathode-ray tube (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 signal(s) 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, 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. Also, the analog signals from the Storage circuitry are supplied to the diode gate which is switched on to pass the storage vertical signal to the Delay Line Driver.

Final amplification of the vertical signal (either STORE or NON-STORE) 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 sweep 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 to the X-Axis 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-x-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 data 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 μ s 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 and increasing the Z-Axis current. 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-x-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 if selected. However, in ROLL mode, the channel data is read out directly from the Acquisition RAM and not the Waveform RAM.

Z-AXIS

The Z-Axis drive signal, from either the Sweep Logic circuit or the storage 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 Preamplifier circuit) blanks the crt display while switching between the 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.

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 produces the accelerating, focus, and cathode potentials used by 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

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/division 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 the 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.

Input Coupling (AC-GND-DC)

A signal from the CH 1 OR X input connector 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.

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 VOLT/DIV switch settings above 5 mV/DIV, 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.

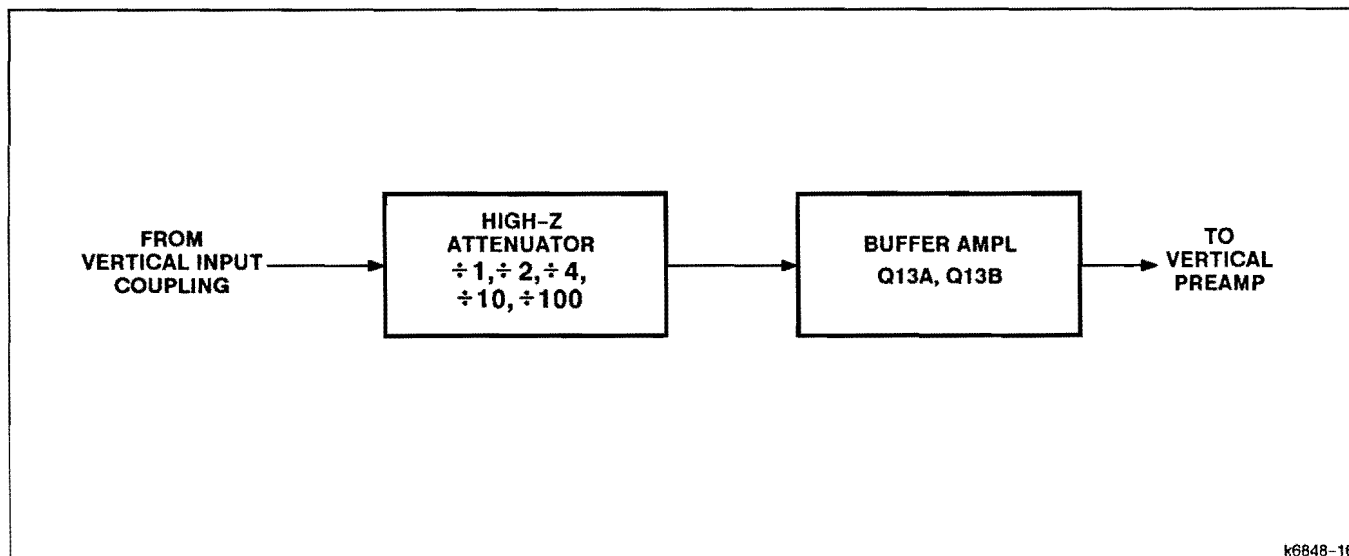


Figure 3-1. Block diagram of the Channel 1 Attenuator circuit.

Source Follower

The CH 1 signal from Input Attenuator AT1 is connected to source follower Q13A via R6 and C6. Resistor R5 provides the input resistance. FET Q13B is a constant current source for Q13A. Field-effect transistors 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 Q13A, a source follower, the signal will be limited by CR7 and the gate-source junction of Q13A. If an excessive negative-going signal causes CR7 to become forward biased, the gate of Q13A is clamped to approximately -9.3 V. An excessive positive-going signal will forward bias the gate-source junction of Q13A. 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 Q13B 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.

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.

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).

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 provide 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 to 7.8 MHz by C110.

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.

Channel Switching

NON-STORE MODE. In NON-STORE mode, when 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 open-collector 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 the STORE line, and are, therefore, turned off. CH 1 is therefore connected to the Delay Line Driver, and no signal is fed to the CH1 acquisition circuit.

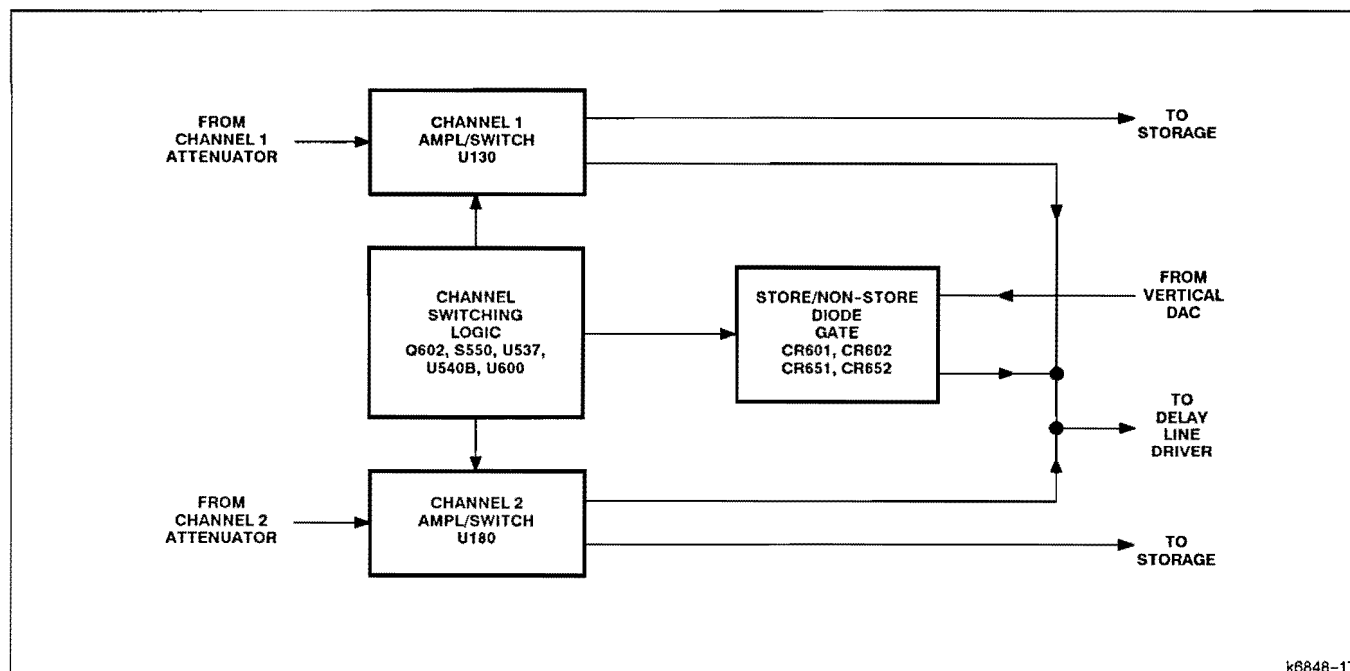


Figure 3-2. Block diagram of the Channel Switching circuit.

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 CH2 is selected instead, the other two transistors in U130 will conduct, sending the CH1 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.

STORE MODE. In STORE mode Q602 is biased off, 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 off so that CH1 and CH2 signals are sent to the CH1-ACQ and CH2-ACQ circuits respectively, instead of the Delay Line Driver.

The other effect of Q602 being off is that diodes CR601 and CR651 are reverse biased and do not supply the bias current for the Vertical Interface via R604 and R654. The current flows instead through CR602 and CR652, a low impedance path for the analog signal from the Storage board to the Delay Line Driver.

CHANNEL SWITCHING. The Channel Switching circuitry uses the setting of the front-panel Vertical MODE switches for acquisition 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 $\bar{Q}$ 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.

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

$\bar{Q}$ 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.

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. This forces the Q and $\bar{Q}$ 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 CHOP ENABLE 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 U540A via U537B. The output of U537C also supplies the CHOP clock to the Chop Blanking circuit.

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.

The $\bar{ALT SYNC}$ 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 $\bar{Q}$ output of U540B is connected back to the D input, and both the 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 CHOP ENABLE line is held HI, disabling CHOP multivibrator U537D. The output of U537C will be HI and the CHOP BLANK signal from U537A will be LO. Input signals to U537B are the HI from U537C and the $\bar{ALT SYNC}$ signal from the Holdoff circuitry in the Sweep Logic. The output of U537B will then be the inverted $\bar{ALT SYNC}$ 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 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. 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 may 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. 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 8) adjusts the Delay Line Driver amplifier biasing to limit the voltage swing at the crt plates. When S390 (circuit diagrams 7 and 8) 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 dynamic range of the amplifier.

Reference Position Control

The circuit consisting of Q277, Q283, Q284, Q285, 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, the REF_POS(L) signal from the Storage system is LO, and Q283 is biased off. This allows REFERENCE POSITION potentiometer R280, via emitter-follower Q277, to affect the bias on one side of a differential current source composed of Q284 and Q285. The potentiometer supplies a dc offset current to the Vertical Output Amplifier 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. The base voltages of Q284 and Q285 are then the same, and equal current is supplied to both sides of the amplifier so that no offset of the trace occurs.

TRIGGER (diagram 4)

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 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 $\overline{\text{CH1 EN}}$ and $\overline{\text{CH2 EN}}$ 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 U315B and U315C for CH 1 and U325B and U325C for CH 2. The circuitry associated with CH 2 is the same as CH 1 except that it does not have a trigger-offset adjustment.

Differential vertical signals from the CH 1 Preamplifier go to U315B and U315C. These emitter-follower 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 compensation and biasing network connected between the emitters of the input transistors in U335 is fixed for CH 2 but not for CH 1. Potentiometer R338 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 base 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 being set to CH 1, VERT MODE, or CH 2. The logic function required to generate CH 1 TRIG and CH 2 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 is set to CH 1, or

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

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 as the trigger signal when CH 2 is displayed. Those conditions are:

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

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

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 the 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 8). In each case, the buffer consisting of Q370A and Q370B (diagram 8), 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, switches on the external trigger path.

Trigger Amplifier

The Trigger Amplifier 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. That load is driven via cascode transistor Q368 and "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.

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 6). 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 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). 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.

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.

Trigger Level Comparator

The Trigger Level Comparator 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 a 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 trigger jitter by increasing positive feedback at higher frequencies. The setting of R489 determines the circuit hysteresis.

When TV FIELD is not selected, the $\overline{\text{TVF}}$ 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 $\overline{\text{TVF}}$ 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.

SWEEP LOGIC (diagram 5)

The purpose of the Sweep Logic circuit (circuit diagram 5) is to control the sweep start dependent upon the trigger signal and Trigger MODE setting. It also provides the signal for Alternate Channel Switching. See Figure 3–3 for a simplified block diagram of the Sweep Logic circuit.

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 12V, 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.

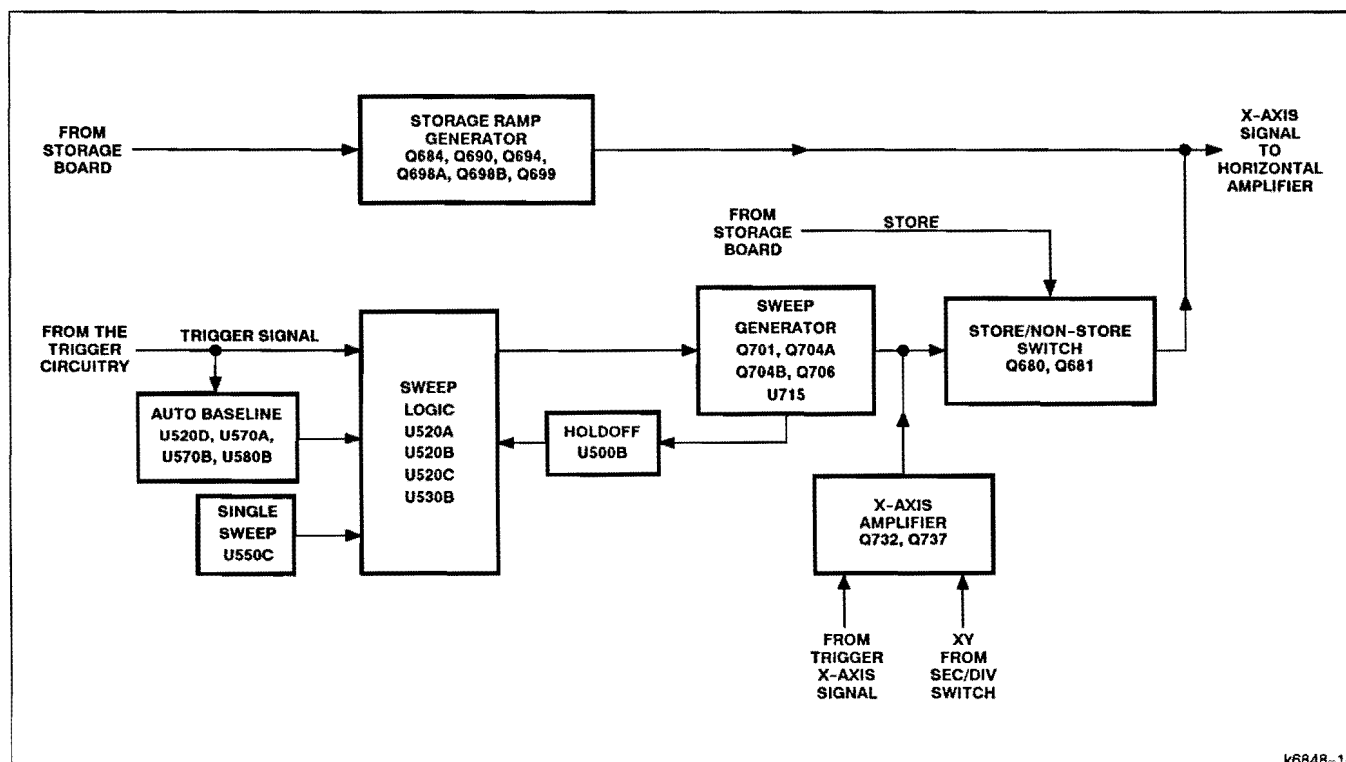


Figure 3–3. Block diagram of the Sweep Logic and Sweep Generator circuits.

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 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 $\overline{\text{GATE}}$ 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 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 the 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 $\overline{\text{ALT SYNC}}$ 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 ($\overline{\text{ALT SYNC}}$ 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 5, 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 6)

The Miller Sweep Generator and Storage Ramp Generator circuitry, shown on circuit diagram 6, produce linear voltage ramps that drives 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 X-Axis 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 (circuit diagram 5) is biased off. The $\overline{\text{GATE}}$ 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.

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 Pre-amplifier in the X-Amplifier (diagram 7).

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 is 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 the 0.5 ms to 10 μs SEC/DIV ranges to correct for mismatch between timing capacitors C701 and C702.

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 X-Axis 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 4 ms. Transistor Q684 is turned off while the trigger point is displayed so that the electron beam dwells a little to increase the brightness at that point by more than would have been possible with the Z-Mod control alone. 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 X-Axis 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 $\overline{\text{XY}}$. The switch disables XY in STORE by connecting the $\overline{\text{XY}}$ line. In X-Y STORE mode, the $\overline{\text{XY}}$ 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 X-Axis Amplifier (diagram 7).

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

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

X-AXIS AMPLIFIER (diagram 7)

The X-Axis 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, or from the X-Y Amplifier in X-Y display mode. See Figure 3-4 for the block diagram of the X-Axis Amplifier.

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

X-Signal Input

X-Signal input current is applied to a shunt feedback stage consisting of U745A, U745B, R741, R742, R743, R744, and R745 (diagram 7). 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.

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.

X1/X10 MAG Horizontal Preamplifier

The X1/X10 amplifier is a cascode 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 U755E are biased off, and U755A and U745E are biased on. Diodes CR773 and CR774 are reverse biased. The gain will then be set by R763.

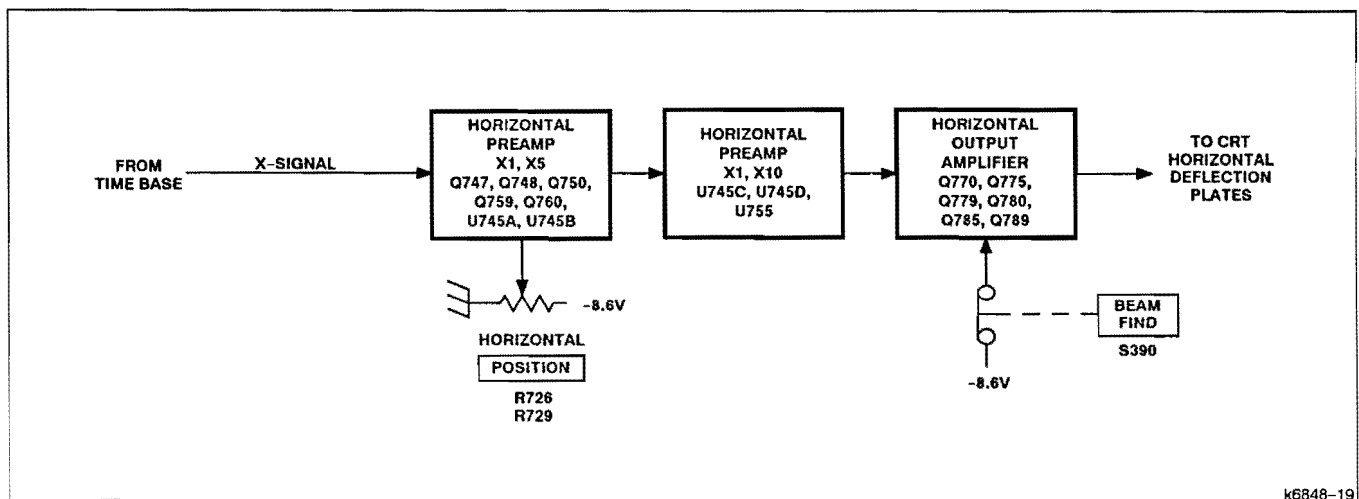


Figure 3-4. Block diagram of the X-Axis Amplifier circuit.

When X10 MAG is HI, U755B, U755E, CR773, and CR774 are biased on, and U755A and U745E are biased off. 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. Capacitors C773 and C755 damp the high-frequency gain of the preamplifier.

Horizontal Output Amplifier

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

Signals from the + and - outputs of U755 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 8) 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 8)

The Front Panel controls diagram shows the complete Front Panel circuitry to aid in servicing that circuit board. Many of the switches and potentiometers are also shown on the other schematic diagrams adjacent to the circuitry controlled. 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.

Z-AXIS AND CRT (diagram 9)

Current Summing

The Z-Mod Amplifier controls the crt intensity via several signal sources that vary the intensity or completely blank the screen. The trace intensity depends on the current flowing into the summing node at the junction of CR828, R841, and R835. The value of this current is ordinarily determined by the values of the resistors R820, R825, R821, R818, and the voltage on Q804 emitter, which is itself controlled by the 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 $\overline{XY}$ is LO then CR820 conducts, supplying the summing node with the current necessary for a display in XY mode. If $\overline{XY}$ is HI, this current flows instead through CR819.

Diode CR821 passes current through R821 to turn the beam on during sweep (when the $\overline{GATE}$ 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 to the summing junction.
- the instrument is not in STORE mode. If in STORE, CR823 conducts to divert the current to the summing junction.

Storage Operation

STO_DISZ is used by the Storage board to turn the beam off during retrace in STORE mode. If STO_DISZ is HI, then CR817 conducts, diverting the current and increasing the intensity. If STO_DISZ is LO, CR818

conducts and the intensity is increased. Diodes CR824 and CR825 allow the BRIGHT_ON(L) signal to increase the beam intensity slightly to show the trigger point.

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 1ma current through R819 overrides any other current combinations to ensure a visible trace. The application of an external Z-Mod voltage, from the front panel input connector, will also vary the current through R823 and therefore the intensity.

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 a 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.

Intensity Compensation

At high beam currents, the crt cathode voltage tends to drop off slightly. To compensate for this, the 2-kV winding is referenced to the emitter of Q804, through the filter formed by C805, R806. The effect of this circuit reduces the output of the HV multiplier (U975) slightly at high intensity levels.

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.

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 C854 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.

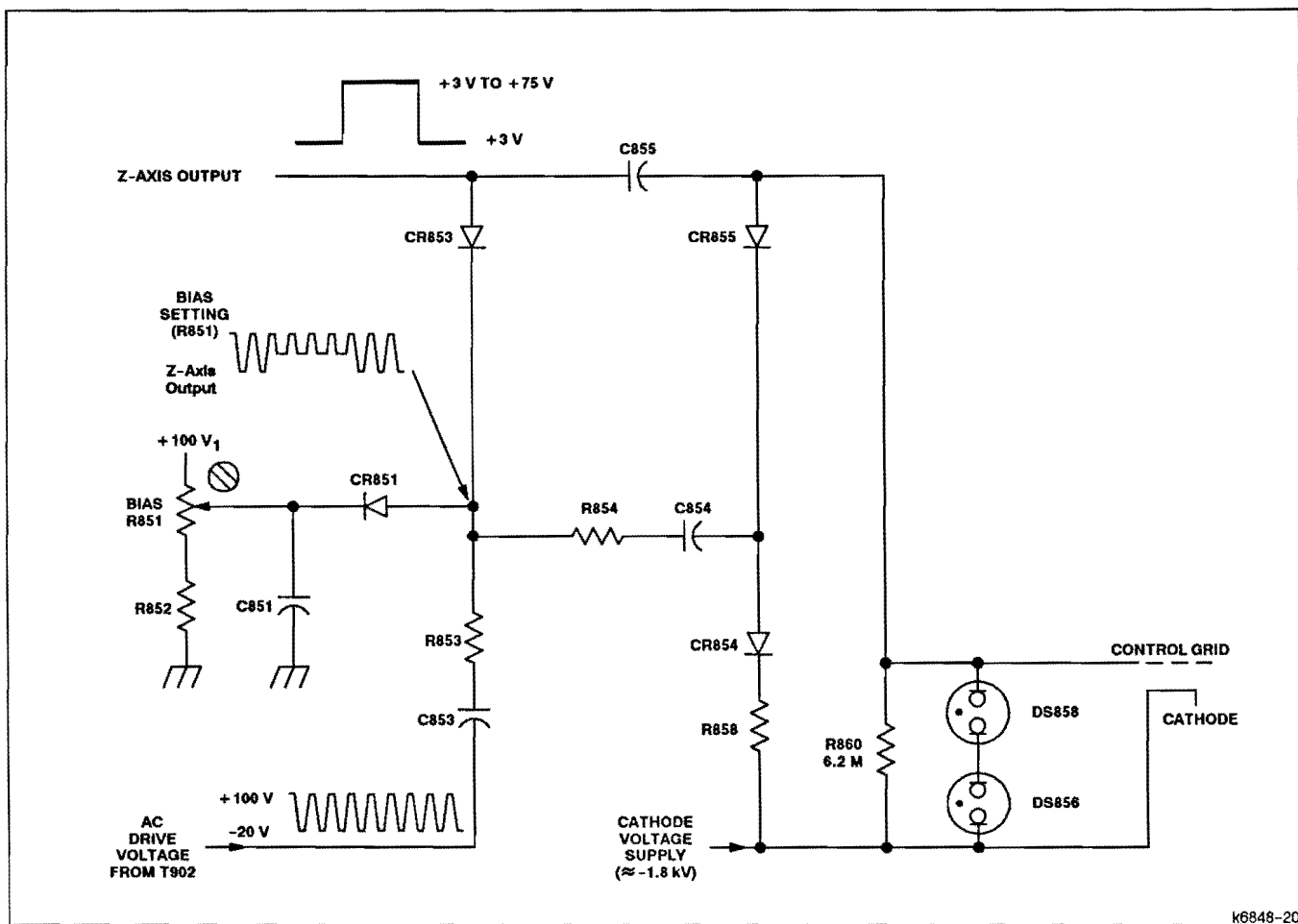


Figure 3-5. Simplified diagram of the Grid Bias DC Restorer circuitry.

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 or the cathode is lost for any reason.

HV Multiplier

High-voltage multiplier U975 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 R975, 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, R886, and Q885. The focus voltage tracks the intensity level through the action of Q885. The emitter voltage of Q804, set by the INTENSITY control, is applied to the emitter of Auto Focus transistor Q885 through R885. When the emitter voltage of Q804 changes, the current through Q885 changes proportionally and alters the voltage at one end of the FOCUS control.

POWER SUPPLY (diagram 9)

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 VOLTS SELECTOR switch S902. The secondary output is rectified and smoothed by CR901, CR902, CR903, CR904 and C900. With an ac-input voltage of 240 V, there is approximately 60 V between W903-pin 1 and W903-pin 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 of 180 mV developed by R910 and R911, and U910 current limits the output to about 900 mA.

Series Pass

The function of 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 and CR923 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 38-V 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 $+5.1\text{ V}$ 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.

STORAGE SYSTEM (diagram 10)

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

Vertical Interface (diagram 11),
Acquisition System (diagram 12),
Display System (diagram 16),
Clock and Time Base (diagram 19), and
Z-Axis, Power Supply, and Storage Switches (diagram 20).

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 11)

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. These resistors 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 are 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 set 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 $+1.5$ 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 channel 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 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 $+1\text{ V}$ 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 ($20\text{ }\mu\text{s/div}$) is selected, the clock runs at 20 MHz. On all other SEC/DIV switch settings, the A/D clock runs at 8 MHz.

The A/D Converter uses 256 comparators, with one input of each comparator connected to the analog input signal. The other input is connected to the internal reference resistor ladder chain. This chain is composed of a string of equal value resistors so as to provide 256 equally spaced voltages for the comparators. The voltage difference between adjacent comparators corresponds to 1 LSB of the input range.

REFERENCE VOLTAGE. The reference chain is driven by a stable $+1\text{ V}$ and -1 V (applied to pins 24 and 23 respectively) voltage source. A 5-V regulator, U1101, supplies an input of 5 volts to inverting operational amplifier U1102A. Resistors R1102 and R1106 set the gain, giving an output of -1 V at the emitter 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 12)

The acquisition system is divided into two main areas, the Acquisition Data Path (diagram 13) and the Acquisition Control Section (diagram 15).

The main parts of the Acquisition Data Path consist of the Channel Data Latches, the Acquisition RAM, CH1 and CH2 Display Buffers, and the Status Latches (diagram 13).

The Acquisition Control section consists of the Record State Machine, Roll State Machine, the Timing Generator, and Trigger Control Logic (all on diagram 15).

ACQUISITION DATA PATH (diagram 13)

Output data from the Channel A/D Converters (diagram 11) 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 18). 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). Hence, 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

17). 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 in 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 13) are U1502C, U1503, U1765A, U2253D, U3001A, and U3204A. 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 oscilloscope is in single-sweep or untriggered ROLL. For single-sweep mode, INIT is used. However, 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 U3001A 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 14)

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, U1509, U1510, and U1511, 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 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. Then, 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 15)

Data Acquisition

The acquisition of data is controlled by two state machines (see diagram 15). 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 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.

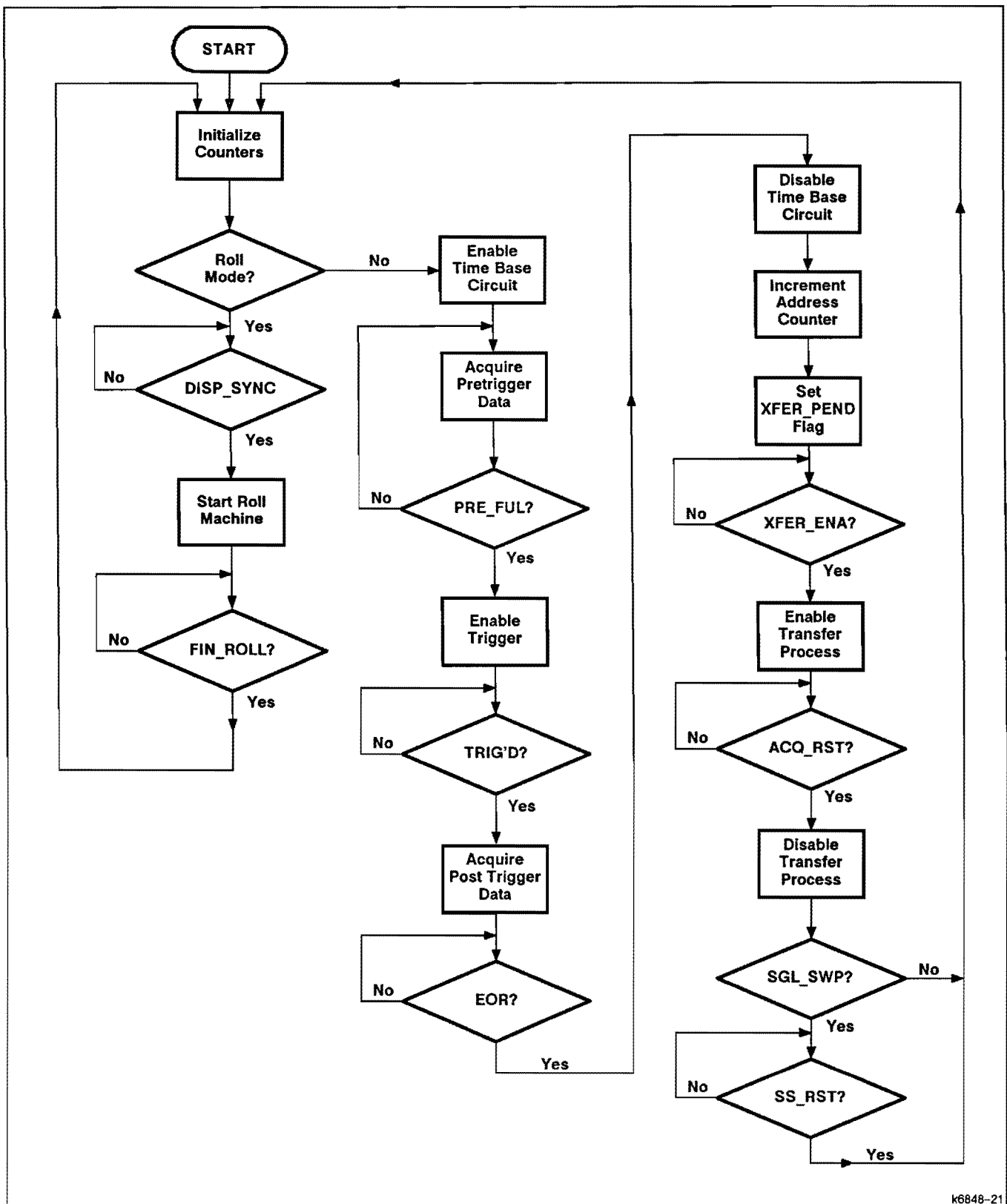


Figure 3-6. Record Mode flow diagram.

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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.

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 is done 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 in parallel 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 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 RAM. This ensures that the Record Counter is only clocked once for each SAV_CLK_P pulse 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 the 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 HI by resistors in resistors 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 occurrence of PRE_FUL indicates that the 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 15)

The components associated with the Timing Generator are U1755, U1756, U1757, U1758, U1760, U1524D, and U7002C and D. 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 U1758 and U1760. This ensures accurate timing relationships with the 40-MHz clock and compensates for the time delays through 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 U1758A delays the WR_CLK(L) output by one clock cycle.

Alt Trigger Circuit (diagram 15)

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

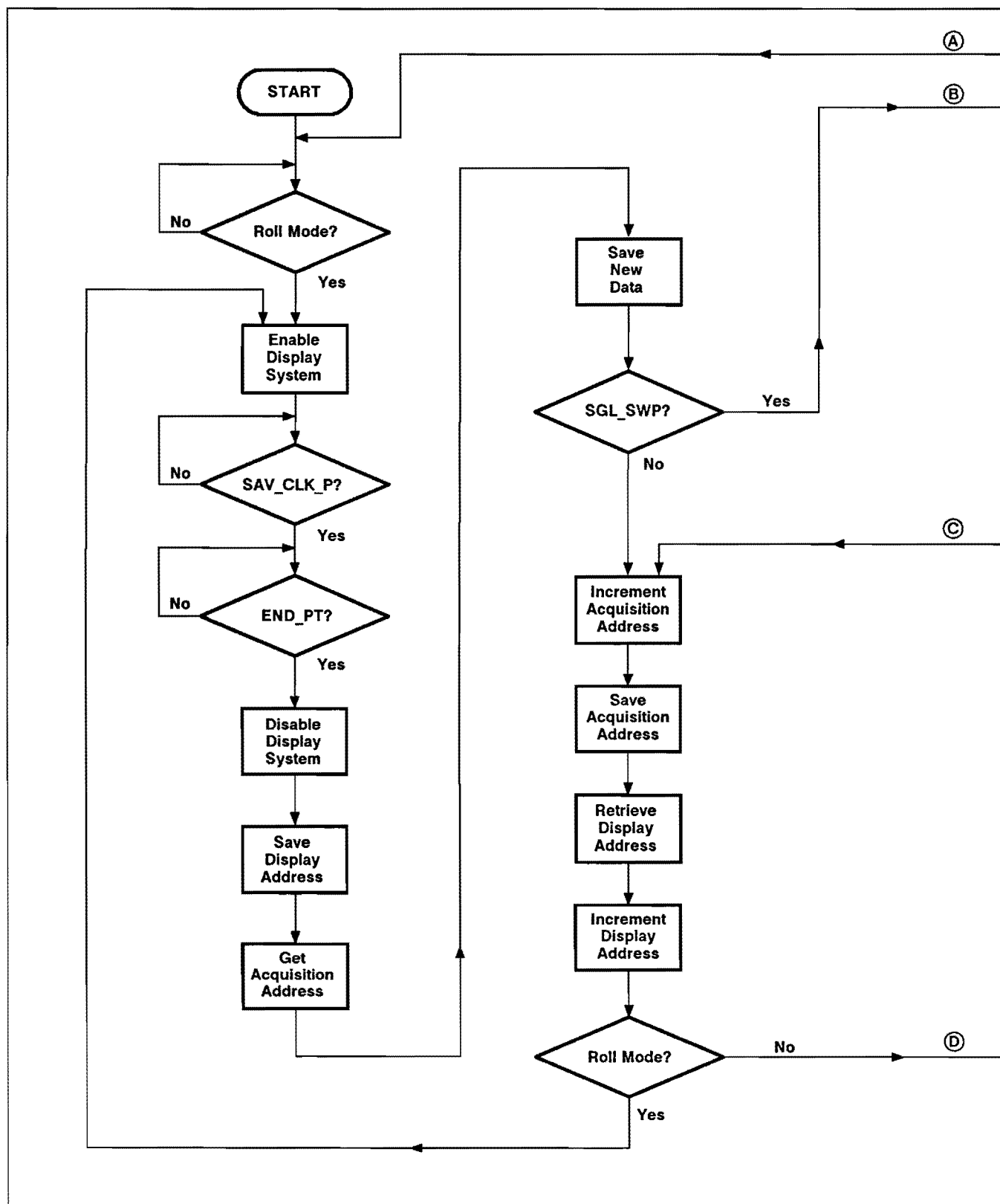


Figure 3-7a. Roll Mode flow diagram.

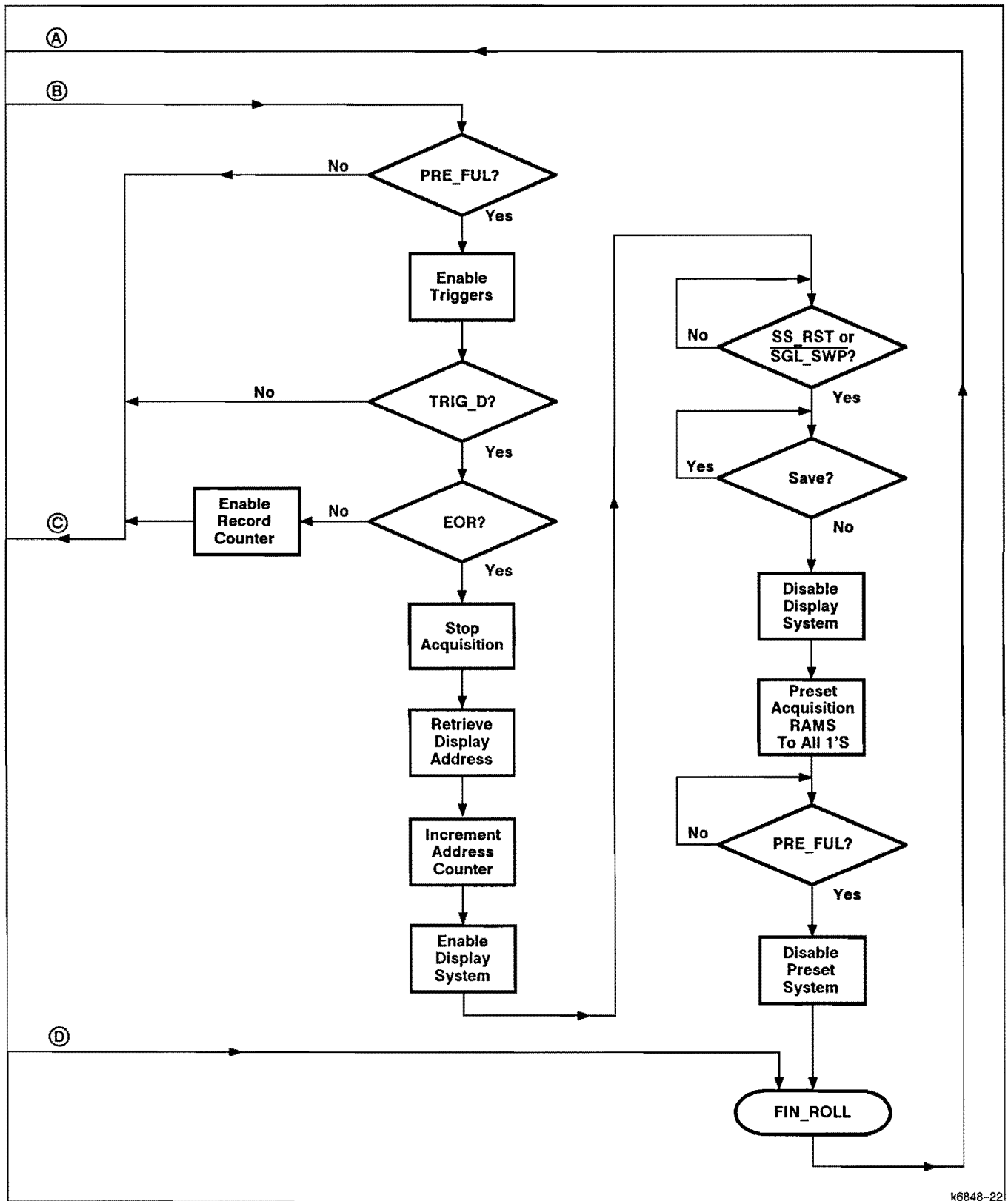


Figure 3-7b. Roll Mode flow diagram.

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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 CH1_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 and removes the clear signal from U1751, thus enabling the Synchronizer to respond to the next GATE signal. Latch U1751A gets clocked by the GATE signal, and its output is synchronized to the 20MHz_A clock by U1751B. AND-Gate U1764D is used to generate STO_RDY. The STO_RDY signal indicates that triggers have been enabled and that the instrument is in SGL SWP mode. In SGL SWP mode, U1750B and U1750C generate ENA_TRIG_SS(L); this signal gets unasserted after TRIG_ENA has occurred. The ENA_TRIG_SS(L) signal is used by the analog portion of the instrument to inhibit sweeps.

DISPLAY SYSTEM (diagram 16)

The Display System is divided into two main areas: the Display Data Path (diagram 17) and the Display Controller (diagram 18). The main parts of the Display Data Path consists of the Address Counter, Display RAM, Vertical DAC output circuit, and Status latches. 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 17)

The Display Address Counter, U2001, generates the addresses for the Display RAMS, U2006 and U2005. Selection between these two RAM for display or writing data into them is by address line DRA13. That signal, after being inverted by U2004A, drives 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.

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 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 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 SAV 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 18) 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 three active inputs: DC_CLR, SPT, 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 (trigger point) is asserted.

Two other signals are generated by the counter: 4K_TC and TP. 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 the CH1, CH2, REF1, and REF2 data blocks. The trigger point signal (TP) is active during the period that the address corresponds to the selected trigger position.

Status Registers

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

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 before being latched into Vertical DAC Latch U2007. The latching signal, END_PT, is generated by the Display Timing Generator. The output of the DAC latch feeds the Vertical Digital-to-Analog Converter (DAC), U2501.

The reference voltage for the Vertical DAC is taken from the regulated 5 V generated by U1101 (diagram 11), R2502, R2510, and R2509. Variable resistor R2509 sets the vertical gain for the DAC. Components C2500 and R2501 are used to remove the transition noise that occurs when the digital inputs pass through half full scale. The output current from the DAC is converted to a voltage by U2502A. This amplifier gives an output voltage swing of approximately 3 volts for a DAC current of 2 ma. Capacitor C2503 limits the high-frequency response to approximately 1 MHz. The output of U2502A feeds the differential amplifier formed by Q2501, Q2502, R2506, R2505, and R2507. The differential outputs drive the vertical deflection system of the oscilloscope (diagram 2).

DISPLAY CONTROLLER (diagram 18)

The Display System (diagram 16) is controlled by three state machines. The Display State Machine U2261, the Block State Machine, U2262, and the Display Timing Generator, U2259, are all pre-programmed, CMOS PAL (programmable array logic devices).

The other components of the control system include the Block Decoding logic, the Trigger and Retrace monostable multivibrators, 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 13 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, BLK0(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 is to be displayed.

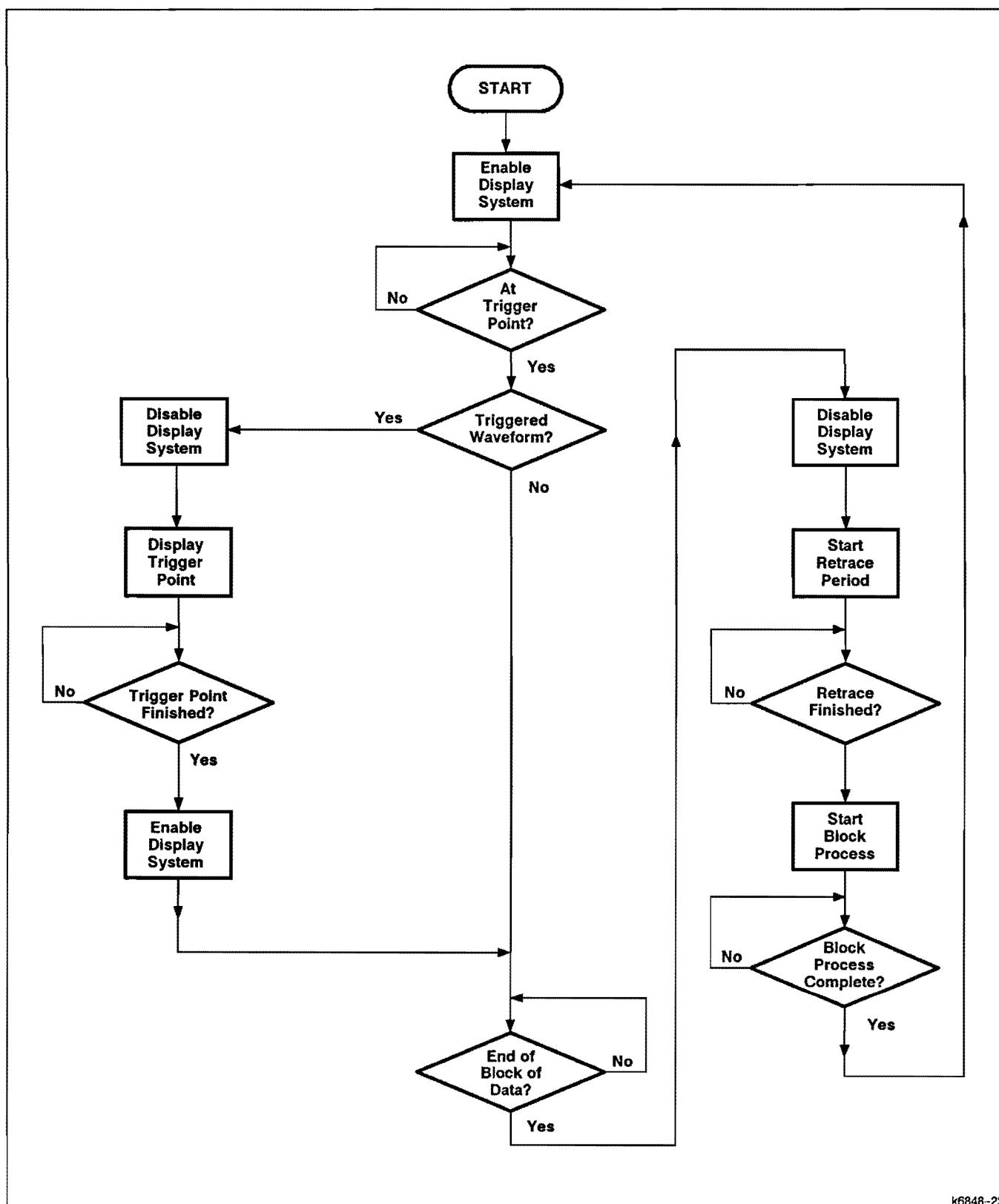


Figure 3-8. Display States flow diagram.

If the trigger point is to be displayed, then the machine waits for TP_S from the Display Address Counter. When TP_S gets asserted, the Display State Machine initiates the Trigger Monostable (U2257B) by asserting TRIG_TP(L) and disables the Timing Generator. The Trigger Monostable generates a 20- μ s pulse (timing set by components R2251 and C2251). The monostable output, TP_MONO, is synchronized by U1500 and fed back to the state machine. Synchronization of TP, TP_ENA, and also 4K_TC is done by U2008. During this period, U2258B and U1750D assert DWELL(L) which inhibits the Storage Ramp (diagram 6).

At the end of the trigger display period, the machine enables the Timing Generator and waits for the end of the data block. On the first occurrence of an END_PT, the output of U2258B is asserted, causing the DWELL(L) signal to go HI, allowing the Storage Ramp Generator to continue the sweep.

At the end of the data block the display is blanked by asserting BLANK, and the Retrace Monostable multi-vibrator (U2257A) is triggered by TRIG_RET. The retrace period, set by R2250 and C2250, is also 20 μ s. 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

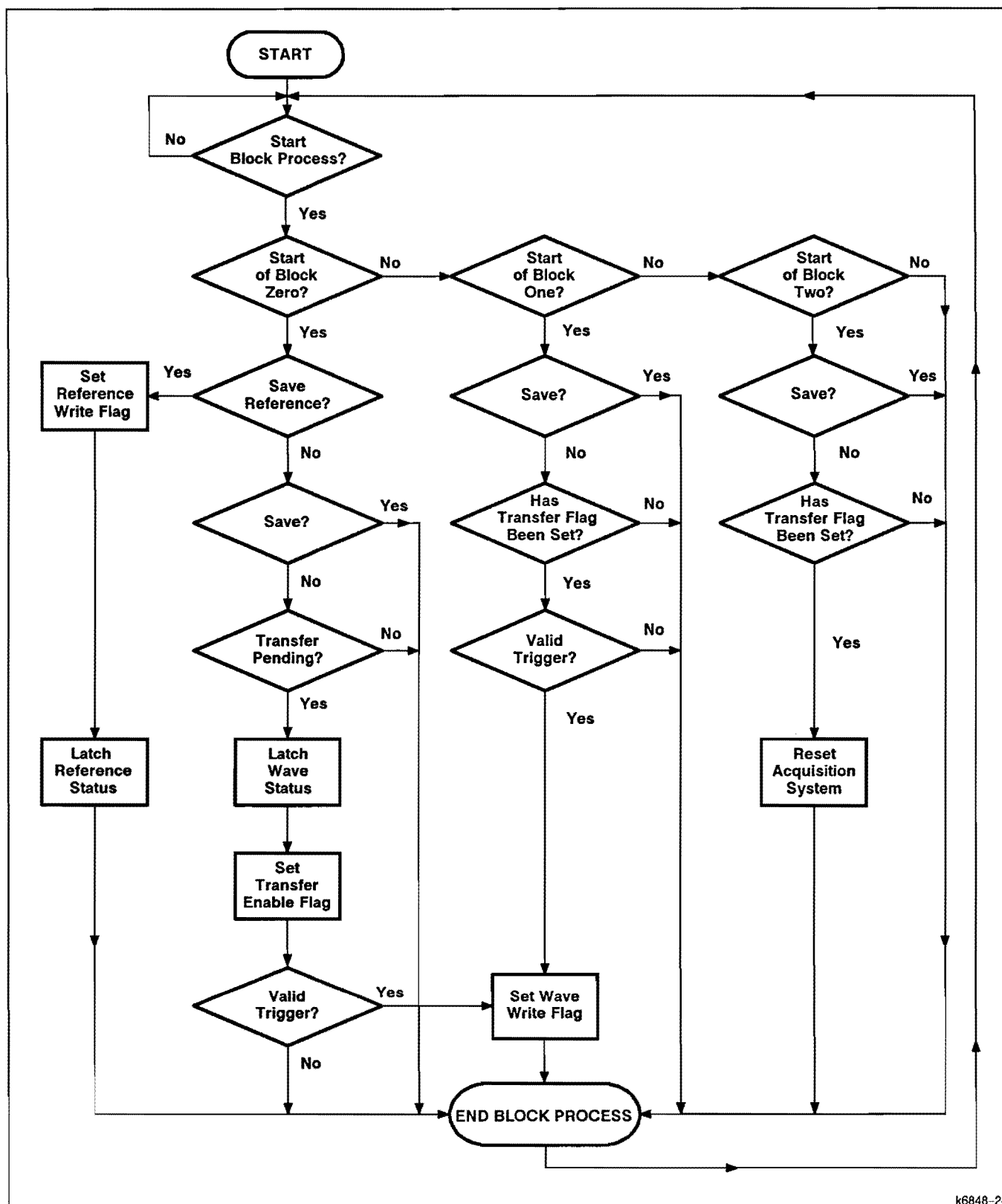
The Block State Machine (U2262) has a total of 12 inputs and 8 active outputs. The state of the outputs is purely a function of the current state of the machine except ALT_BLANK. ALT_BLANK is dependent on the inputs DS6, BLK0(L), BLK1(L), BLK2(L), BLK3(L), and CH1_TRIG. The operation of the Block State 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 BLK0(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. BLK0(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 (BLK0(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.

Table 3-1
Block Activities

BLOCK	DISPLAY	RECORD Mode Events	ROLL Mode Events
BLOCK 0	CH 1 Data	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).	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).
BLOCK 1	CH 2 Data	Transfer data from the Waveform RAM to the Reference RAM for a SAVE REF (data is displayed during transfer).	
BLOCK 2	REF 1 Data	Display data from the Reference RAM	
BLOCK 3	REF 2 Data		



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Figure 3-9. Block State Machine Flow Diagram.

In Block 0 and with a XFER_PEND signal (and SAV_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.

In Block 0, SAV_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 exited.

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 com-

pletion 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.

At the end of 1 μ s, if the WAVE_WR flag is set, WAVE_WR_CLK(L) is asserted for 100 ns. If the REF_WR flag is set, then REF_WR_CLK(L) 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(L) 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_STORE 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 WAVE_WR process, U2253C ensures the decoder is held in an enabled state. This means that the 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 from components U2251D, U1502A, U1750A, U3204D, and U1766B. In RECORD mode, TP_ENA is normally asserted, and in ROLL mode it is unasserted. TP_ENA is used by the Display State Machine 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 pre-trigger data is acquired and a trigger has occurred. In this mode, TR_ROLL is normally asserted. This means that the flip-flop formed by U3204D and U1766B determines the state of TP_ENA.

At the start of a ROLL single sweep acquisition, INIT resets the flip-flop which unasserts TP_ENA. This allows the display system to roll without a trigger point being displayed. When pretrigger data has been acquired, the STO_RDY signal gets asserted. This sets the flip-flop and asserts TP_ENA and indicates to the Display State Machine 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 U2251C, 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 19)

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(L), 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 U7002A. The output of U7002A 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 U7003B, U7004A, B, and C, and U7005 generates the 8-MHz signal from the 40-MHz system clock.

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 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 20 μ s_SEL(L) and 50 μ s_SEL(L). These lines are buffered by U2004E and U2004D. Diodes CR7011 and CR7012 and pull-up resistor R7018 form a diode OR-gate for MUX0 and CTRL_ERROR. This allows CTRL_ERROR to force SO HI and select 20 MHz as the source for SAV_CLK(L) and CONV_CLK. This occurs if a SEC/DIV switch setting greater than 20 μ s per division is selected in STORE mode.

SAV_CLK(L) is delayed and synchronized by U1521D, U7002E, 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 μ s 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 U7002B and U7009A and B by ACQ_ENA. The counters are loaded with a value corresponding to the state of the SEC/DIV switch-decode lines (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.

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.

Table 3-2
Divider-Chain Logic Table

SEC DIV	DEC4(L)	DEC3(L)	DEC2(L)	DEC1B(L)	DEC1A(L)	50 μ S SEL(L)	20 μ S SEL(L)	CTL ERROR	ROLL	X100 SEL(L)	CONV CLK	SAV CLK
50n	0	0	0	1	1	1	1	1	0	1	20M	20M
0.1 μ	0	0	0	1	1	1	1	1	0	1	20M	20M
0.2 μ	0	0	0	1	1	1	1	1	0	1	20M	20M
0.5 μ	0	0	0	1	1	1	1	1	0	1	20M	20M
1 μ	0	0	0	1	1	1	1	1	0	1	20M	20M
2 μ	0	0	0	1	1	1	1	1	0	1	20M	20M
5 μ	0	0	0	1	1	1	1	1	0	1	20M	20M
10 μ	1	0	0	1	1	1	1	1	0	1	20M	20M
20 μ	1	0	0	1	1	1	0	0	0	1	20M	20M
50 μ	1	0	0	1	1	0	1	0	0	1	8M	8M
0.1m	1	1	1	0	1	0	0	0	0	1	8M	4M
0.2m	1	1	1	1	0	0	0	0	0	1	8M	2M
0.5m	1	1	1	0	0	0	0	0	0	1	8M	800K
1m	1	1	0	0	1	0	0	0	0	1	8M	400K
2m	1	1	0	1	0	0	0	0	0	1	8M	200K
5m	1	1	0	0	0	0	0	0	0	1	8M	80K
10m	1	0	0	0	1	0	0	0	A	B	8M	40K
20m	1	0	0	1	0	0	0	0	A	B	8M	20K
50m	1	0	0	0	0	0	0	0	A	B	8M	8K
0.1s	0	0	0	0	1	0	0	0	1	B	8M	4K
0.2s	0	0	0	1	0	0	0	0	1	B	8M	2K
0.5s	0	0	0	0	0	0	0	0	1	B	8M	800Hz
XY	0	0	0	1	1	1	1	0	A	1	EXT CLK	EXT CLK

A indicates normally 0 unless SEC/DIV UNCAL is selected by the user, then A is 1.

B indicates X100_SEL(L) is asserted during ROLL modes only when SEC/DIV UNCAL is selected by user.

Decode Circuit

Decoding of the SEC/DIV switch lines is done by U7066C and D and U7018C. Components R7009, CR7006, CR7007, CR7008, U2004B and C, U7018D, U7066A and B, U2255A and B, and U7003A also decode the SEC/DIV switch lines and generate ROLL_FLAG.

AND-gates U7018A and U7018B detect when both MUX1 and MUX2 are asserted and assert CTL_ERROR if in STORE mode. This signal is used to indicate that an illegal SEC/DIV setting has been selected in STORE mode.

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

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 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 0–5V 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 of 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, since Q7503B has zero gate voltage, 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.

Z-AXIS, POWER RESET, AND STORAGE SWITCHES (diagram 20)

Z-Axis Circuit

The Z-Axis circuitry consists of U8003, U2255C, U2004F, U1502B, and U3203B, F, and E. Components R8001 and C8001 set the time constant for the 2-Hz oscillator formed by U3203F and buffered by U3203E. This oscillator is used to flash the display when a SEC/DIV switch setting faster than 20 μ s is selected in STORE mode. Flashing is done by modulating the Z-Axis drive signal (STO_DISZ) from U2255C. The input to this gate is the BLANK_DISP signal after it has been inverted by U8003A. This signal is gated with the oscillator output by U8003C when CTRL_ERROR is asserted. If CTRL_ERROR is not asserted, the output of U8003B remains asserted removing the oscillator output from the STO_DISZ signal.

Additional Z-Axis modulation is provided by the signal BRIGHT_ON. This is applied during the trigger point display period or if CTRL_ERROR is asserted. This is achieved through the action of U8003D and U1502B.

The BRIGHT_ON signal is inhibited by U2004F when STO_DISZ is asserted.

The power-reset circuit consists of R3201, CR3200, C3201, U3203C and D, and U3204B. The RC time constant is approximately 0.5 sec. 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 U3006A, and the REF_ON flag, from U3005B, are also cleared at this time by the action of U3204C and U3204B respectively. The switch-debounce function is provided by a pair of cross-coupled inverters. Debounce is provided by U3001 and U3002 for four of the front panel switches. The STORE/NON-STORE switch does not need debouncing, as a PWR_RST is applied during NON-STORE mode by U3001F.

POWER DISTRIBUTION (diagram 21)

Power routing from the power supply to the other circuit boards is shown in circuit diagram 21. The schematic shows jumpers that may be used to isolate suspected loads from the power supply when troubleshooting power supply problems.

CIRCUIT BOARD INTERCONNECTIONS (diagram 22)

The signal interconnections between the analog host instrument and storage board are shown in circuit diagram 22. The connectors are convenient locations to check for the signals between boards when troubleshooting. The interconnections between the Storage board circuits are shown in circuit 10. Diagram 12 shows the interconnections for the Acquisition system and diagram 16 for the Display system.

All the circuit interconnection diagrams may be used as an aid in signal tracing between the boards and between the Storage board schematics.

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 (+68°F and +86°F). 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. 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: $\pm 0.3\%$. 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: $\pm 0.5\%$.	Signal source for gain and transient response checks and adjustments.	TEKTRONIX PG 506 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: $\pm 0.1\%$. Trigger output: 1 ms to 0.1 μ s. time-coincident with markers.	Horizontal checks and adjustments. Display adjustment.	TEKTRONIX TG 501 Time-Mark Generator. ^a
4. Low-Frequency Sine-Wave Generator	Range: 1 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 $\pm 5\%$ at 5 V p-p amplitude.	Signal source for storage board external clock checks.	TEKTRONIX PG 502 250 MHz Pulse Generator.
6. Screwdriver	Length: 3-in. shaft. Bit size: 3/32 in.	Adjust variable resistors.	Xcelite R-3323.
7. Test Oscilloscope with 20X Probes	Bandwidth: dc to 100 MHz. Minimum deflection factor: 5 mV/div. Accuracy: $\pm 3\%$.	General trouble-shooting, holdoff check.	TEKTRONIX 2235 Oscilloscope.
8. Digital Voltmeter (DMM)	Range: 0 to 140 V. Dc voltage accuracy: $\pm 0.15\%$, 4½-digit display.	Power supply checks and adjustments.	TEKTRONIX DM 501A 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 W Connectors: BNC.	Signal termination.	Tektronix Part Number 011-0049-01.
12. Termination	Impedance: 600 W. Connectors: BNC.	Signal termination.	Tektronix Part Number 011-0092-00.
13. 10X Attenuator	Ratio: 10X. Impedance: 50 W. 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. DAC Calibration fixture	Connects to P2007 to provide fixed digital inputs to the DAC.	Vertical DAC balance and gain adjustments.	Tektronix Part Number 067-1373-00.

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VERTICAL

Equipment Required (See Table 4-1):

Calibration Generator (Item 1)	50- Ω BNC Termination (Item 11)
Leveled Sine-Wave Generator (Item 2)	10X BNC Attenuator (Item 13)
50- Ω BNC Coaxial Cable (Item 9)	BNC Male-to-Miniature-Probe Tip (Item 14)
Dual-Input Coupler (Item 10)	

INITIAL CONTROL SETTINGS

Vertical

POSITION (both)	Midrange
MODE	CH 1, NORM
VOLTS/DIV (both)	5 mV
VOLTS/DIV Variable (both)	CAL detent
Magnification (both)	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
HOLD OFF	MIN
SOURCE	VERT MODE
COUPLING	DC

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 the X10 MAG column of 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 CH 2 controls.

2. Check Position Range

a. SET:

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

b. Adjust the CH 2 VOLTS/DIV Variable control (CAL knob) to produce a 5.25-division display.

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

d. Set the calibration generator output to 0.2 V.

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 coaxial 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

Table 4-2
Deflection Accuracy Limits

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

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

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

g. Set the Vertical MODE switch to CH 1.

h. Repeat Parts b through e using the CH 1 controls.

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

j. Disconnect the test equipment from the instrument.

3. Check High Frequency Compensation

a. SET:

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

b. Connect the positive-going, fast-rise, square-wave output 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, 5-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 $\pm 6\%$ (0.3 division) or less.

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

g. Set the generator to produce a 1-MHz, 5-division display.

h. CHECK—for aberrations of $\pm 4\%$ (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 5-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 CH 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 μ s

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, 6-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 settings from 10 mV to 1 V.

NOTE

For the 1-V-per-division VOLTS/DIV settings, use a 5-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
CH 1 Vertical Magnification	X10 (pull CH1 CAL knob out)

h. Set the generator to produce a 6-division display at 50 kHz.

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
CH 1 AC-GND-DC	GND
SEC/DIV	0.05 μ s

b. Set the generator to produce a 5-division display at 10 MHz..

c. Set Vertical MODE to CH 1.

d. CHECK—that the CH 1 trace 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 1 AC-GND-DC	DC
CH 2 AC-GND-DC	GND

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 CH1 OR X and CH 2 OR Y input connectors.

c. Set the generator to produce a 6-division display at 20 MHz..

d. Set Vertical MODE to BOTH, CH 2 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
SEC/DIV	0.05 μ s
SEC/DIV Variable	CAL detent
MAG	X1

Trigger

SLOPE	Positive ($\neg$)
LEVEL	Midrange
MODE	P-P AUTO
HOLDOFF	MIN
SOURCE	CH 1
COUPLING	AC

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 2 of the center 8 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 COARSE and FINE Horizontal POSITION controls to line up the time markers.

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 X5 and X50 magnification in all "2" decade switch settings, the associated time marker settings give only 5 markers per 10 divisions instead of the customary 10. When checking these ranges, position the markers on the second and ninth vertical graticule lines.

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.

f. SET:

SEC/DIV	0.1 μ s
Horizontal MAG	X10

g. Select 10-ns time markers from the time-mark generator.

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.

Table 4-3
Settings for Timing Accuracy Checks

SEC/DIV Switch Setting	Time-Mark Generator Setting		
	Normal	X10 Mag	X50 Mag
0.05 μ s	50 ns		
0.1 μ s	0.1 μ s	10 ns	
0.2 μ s	0.2 μ s	20 ns	10 ns
0.5 μ s	0.5 μ s	50 ns	10 ns
1 μ s	1 μ s	0.1 μ s	20 ns
2 μ s	2 μ s	0.2 μ s	0.1 μ s
5 μ s	5 μ s	0.5 μ s	0.1 μ s
10 μ s	10 μ s	1 μ s	0.2 μ s
20 μ s	20 μ s	2 μ s	1 μ s
50 μ s	50 μ s	5 μ s	1 μ s
0.1 ms	0.1 ms	10 μ s	2 μ s
0.2 ms	0.2 ms	20 μ s	10 μ s
0.5 ms	0.5 ms	50 μ s	10 μ s
1 ms	1 ms	0.1 ms	20 μ s
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

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 2 of the center 8 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
Horizontal MAG

0.5 μ s
X50

l. Select 10 ns time markers from the time-mark 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 2 of the center 8 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 0.4 division or more.

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 counterclockwise.

c. CHECK—that the spacing between time markers is 2 divisions or less.

d. Return the SEC/DIV Variable knob 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 ccw)

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. CHECK—that 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 an 8-division horizontal display at an output frequency of 50 kHz.

d. Increase the output frequency until the X-Axis (horizontal) deflection amplitude is 5.7 divisions.

e. CHECK—that the test signal frequency is 2 MHz or greater.

f. Disconnect the test equipment from the instrument.

TRIGGER

Equipment Required (See Table 4-1):

Leveled Sine-Wave Generator (Item 2)	Dual-Input Coupler (Item 10)
Low-Frequency Sine-Wave Generator (Item 4)	50-Ω BNC Termination (Item 11)
50-Ω BNC Coaxial Cable (Item 9)	600-Ω BNC Termination (Item 12)

INITIAL CONTROL SETTINGS

Vertical

POSITION (both)	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
SEC/DIV	0.2 μs
SEC/DIV Variable	CAL detent
MAG	X1

Trigger

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

b. Set the generator to produce a 3.5-division display at an output frequency of 5 MHz.

c. Set CH 1 VOLTS/DIV switch to 1 V.

d. CHECK—that a 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. Disconnect the test equipment from the instrument.

h. SET:

CH 1 VOLTS/DIV	20 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 ↘

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.

i. 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.

j. Set the generator to produce a 4-division (80 mV) horizontal display at an output frequency of 5 MHz. *NORM*

k. Repeat Part d.

l. 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	20 ms
Trigger MODE	P-P AUTO
Trigger SOURCE	CH 1
Trigger SLOPE	Positive ($\nearrow$)

b. Connect the low-frequency, sine-wave generator output via a 50- Ω cable and a 600- Ω termination to the CH 1 OR X input connector.

c. Set the low-frequency generator output to produce a 20-Hz, 1-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 External Trigger Range

a. SET:

CH 1 VOLTS/DIV	0.5 V
SEC/DIV	20 μ s
Trigger COUPLING	AC
Trigger SLOPE	Positive ($\nearrow$)

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 the EXT INPUT OR Z input connectors.

c. Set the leveled sine-wave generator to produce a 50-kHz, 5-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 can be untriggered at either extreme or rotation of the Trigger LEVEL control.

i. Set the Trigger SOURCE switch to $\frac{\text{EXT}}{10}$.

j. CHECK—that the display can be triggered about the midrange of the Trigger LEVEL control.

k. Set the Trigger SLOPE switch to negative ($\searrow$) and repeat Part j.

l. Disconnect the test equipment from the instrument.

4. 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 ($\nearrow$)

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 CH 1 AC-GND-DC switch to DC.

NOTE

The INTENSITY control may require adjustment to observe the single-sweep trace.

g. CHECK—that the READY light goes out and a single sweep occurs.

h. Press the SGL SWP RESET button several times.

i. CHECK—that a 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)
Two 50- Ω BNC Coaxial Cable (Item 9)
Dual-Input Coupler (Item 10)

50- Ω BNC Termination (Item 11)
Low-Reactance Alignment Tool (Item 16)
10X Probe (provided with instrument)

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
SEC/DIV	20 μ s
SEC/DIV Variable	CAL detent
Horizontal MAG	X1

Trigger

SLOPE	Positive ($\neg$)
LEVEL	Midrange
MODE	P-P AUTO
HOLD OFF	MIN
SOURCE	EXT, EXT = Z
COUPLING	DC

and a dual-input coupler to the CH 1 OR X and the EXT INPUT OR Z connectors.

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 connector on the instrument front panel. If necessary, adjust the probe compensation for a flat-topped square-wave display.

c. CHECK—that the display amplitude is 4.75 to 5.25 divisions.

d. Disconnect the probe from the instrument.

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 BNC termination,

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 8)
Time Mark Generator (Item 3)	Dual-Input Coupler (Item 9)
Low-Frequency Sine-Wave Generator (Item 4)	50- Ω BNC Termination (Item 10)

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
HOLD OFF	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
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
SAVE/CONTINUE	CONTINUE

h. Repeat parts b through d for CH 2.

i. SET:

STORE/NON-STORE	NON-STORE
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:

Vertical MODE	BOTH, ADD, NORM
SEC/DIV	0.2 ms
VOLTS/DIV (both)	20 mV
STORE/NON-STORE	NON-STORE

b. Set the calibration generator to output a 50-mV standard-amplitude signal and connect it via a dual-input coupler to both CH 1 OR X and CH 2 OR 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 the STORE/NON-STORE switch 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.

3. Check CH 1 Storage Balance

a. SET:

SEC/DIV	0.2 ms
Vertical MODE	CH 1, NORM
CH 1 VOLTS/DIV	5 mV
CH 1 AC-GND-DC	GND
Trigger SOURCE	EXT, 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 switch to STORE.

d. CHECK—that the trace is positioned within 0.5 division of the center horizontal graticule line.

4. Check CH 2 Storage Balance

a. SET:

Vertical MODE	CH 2, NORM
CH 2 VOLTS/DIV	5 mV
CH 2 AC-GND-DC	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 switch to STORE.

d. CHECK—that the trace is positioned within 0.5 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 the STORE/NON-STORE switch to STORE.

d. CHECK—that the trace is positioned within 0.5 division of the center horizontal graticule line.

6. Check Storage Bandwidth

a. SET:

Vertical MODE	CH 1
SEC/DIV	20 μ s
AC-GND-DC (both)	DC
Trigger SOURCE	VERT
Trigger COUPLING	AC

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.

c. Set the generator to produce a 50-kHz, 6-division display.

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 test-signal 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 all CH 2 VOLTS/DIV settings from 5 mV to 0.5 V.

7. Check Store Mode Channel Isolation

a. SET:

CH 2 VOLTS/DIV	1 V
CH 2 VOLTS/DIV	0.5 V
CH 2 AC-GND-DC	GND

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:

CH 1 VOLTS/DIV	0.5 V
Vertical MODE	CH 2

f. CHECK—that the displayed signal amplitude is less than 0.1 division.

g. Move the test signal to the CH 2 input.

h. SET:

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

i. CHECK—that the displayed signal amplitude is less than 0.1 division.

j. Disconnect the test equipment from the instrument.

8. 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 dual-input coupler to both the CH 1 OR X and CH 2 OR Y inputs.

c. Set the generator to give a 6-division display.

d. Set Vertical MODE to CH 2 INVERT, 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.

9. Check Display and Save Ref

a. SET:

Vertical MODE	CH 1
CH 1 AC-GND-DC	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 from 0 to 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 the PRE-TRIG button to 75%.

j. CHECK—that the trigger point on the CH 1 trace changes, but that the trigger point on the Reference trace 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 button to SAVE.

c. CHECK—that the trace cannot be moved vertically using the Vertical POSITION control.

e. Press SAVE/CONTINUE to CONTINUE.

f. 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. Align the start of the trace with the first vertical graticule line using the Horizontal POSITION control.

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.

12. Check Single Sweep

a. SET:

CH 1 VOLTS/DIV	0.5 V
CH 1 AC-GND-DC	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 TRIG'D/READY indicator has gone out, the display should stop scrolling.

h. Press the SGL SWP RESET button.

i. CHECK—that the display clears and the TRIG'D/READY indicator does not light until the pretrigger data (the first 25% of the trace) 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 50- Ω coaxial cable, a 50- Ω BNC termination, and a dual-input coupler to the CH 1 OR X and the CH 2 OR 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	0.1 s
Trigger MODE	SGL SWP.

f. CHECK—that the display continually scrolls to the left.

g. Press SGL SWP RESET button.

h. CHECK—that both channels trigger and remain on the screen.

i. CHECK—that every subsequent press of the SGL SWP 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 the signal is reconnected to the CH 1 input.

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 the signal is reconnected to the CH 2 input.

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.

14. Check External Clock Record Mode

a. SET:

Vertical MODE	CH 1, ALT
SEC/DIV	EXT CLK
Trigger MODE	P-P AUTO
Trigger SOURCE	CH 1

b. Connect a 0-5 V, 10-MHz symmetrical square wave 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- μ 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.

d. Set the SAVE/CONTINUE switch to SAVE.

e. CHECK—that the displayed signal has 2 markers per division.

f. Disconnect the test equipment from the oscilloscope.

15. Check External Clock Roll Mode

a. Set the SAVE/CONTINUE switch to CONTINUE.

b. Turn the Horizontal Variable control (CAL knob) fully counterclockwise.

c. Connect a 0-5 V, 4-kHz symmetrical square wave 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 the SAVE/CONTINUE switch to SAVE.

f. CHECK—that the displayed signal has 1 marker per division.

g. Return the Horizontal Variable control to the CAL detent position.

h. Disconnect the test equipment from the oscilloscope.

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 $+20^{\circ}\text{C}$ and $+30^{\circ}\text{C}$ ($+68^{\circ}\text{F}$ and $+86^{\circ}\text{F}$), 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

REPAIRS MADE	INTERNAL ADJUSTMENTS AFFECTED																			
	-8.6 V ADJ	GRID BIAS, ASTIG. & GEOM	STEP ATTN BAL	VAR BAL & INVERT BAL	CH 1 & CH 2 GAIN	X1/X10 BALANCE	ATTENUATOR COMP	HF COMP	1 ms TIMING	MAGNIFIER GAIN	MAGNIFIER REGISTRATION	10 μ s, 5 μ s TIMING	HIGH SPEED TIMING	X-Y GAIN AND OFFSET	TRIGGER BALANCE OFFSET	TRIGGER HYSTERESIS	SLOPE BALANCE - P-P OFFSET	TRIGGER SENSITIVITY	CH 1, CH 2 & ADD STORAGE BALANCE	CH 1, CH 2 & ADD STORAGE GAIN
POWER SUPPLIES																				
VERTICAL ATTENUATORS																				
PREAMPS & CHANNEL SW																				
VERTICAL OUTPUT																				
TRIGGER CIRCUIT																				
SWEEP GENERATOR																				
HORIZONTAL AMPLIFIER																				
CRT																				
STORAGE																				

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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)

See **ADJUSTMENT LOCATIONS** at the back of this manual for adjustment locations.

INITIAL CONTROL SETTINGS

PROCEDURE STEPS

INTENSITY

Visible display

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 -8.6 V supply (W989).

b. CHECK—voltmeter reading is -8.56 V to -8.64 V. If the reading is within these limits, skip to part d.

c. ADJUST—the -8.6 V Adj potentiometer (R933) for a voltmeter reading of -8.60 V.

d. CHECK—voltage levels of the remaining power supplies listed in Table 5-2 are within the specified limits.

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.

Vertical

POSITION (both)
MODE
VOLTS/DIV (both)
VOLTS/DIV Variable (both)
Magnification (both)

Midrange
CH 1, NORM
10 mV
Cal detent
X1 (CAL
knobs in)
GND

AC-GND-DC (both)

Horizontal

POSITION (COARSE and FINE)
SEC/DIV

Midrange
X-Y (fully
ccw)
CAL detent
X1

SEC/DIV Variable
MAG

Trigger

SLOPE
LEVEL
MODE
HOLD OFF
SOURCE
COUPLING

Positive (—)
Midrange
P-P AUTO
MIN
EXT, EXT
AC

Storage

STORE/NON-STORE

NON-STORE

Table 5-2
Power Supply Limits

Power Supply	Test Point	Reading (Volts)
-8.6 V	W989	-8.56 to -8.64
-5.2 V	W993	-5.04 to -5.35
+5.1 V	W991	+4.95 to +5.25
+8.7 V	W987	+8.53 to +8.87
+38 V	W972	+36.8 to +39.1
+99 V	W984	+96.0 to +101.9

3. Adjust Astigmatism (R874)

a. SET:

Vertical MODE	CH 1
CH 1 AC-GND-DC	DC
SEC/DIV	5 μ s
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 4-division display at 50 kHz..

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- μ 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 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 5 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 CH 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 CH 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 (Item 11)
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)

See **ADJUSTMENT LOCATIONS** at the back of this manual for adjustment locations.

INITIAL CONTROL SETTINGS

Vertical

POSITION (both)	Midrange
MODE	CH 1, NORM
VOLTS/DIV (both)	5 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	0.5 ms SEC/DIV
Variable	CAL detent
MAG	X1

Trigger

SLOPE	Positive (┌)
LEVEL	Midrange
MODE	P-P AUTO
HOLD OFF	MIN
SOURCE	EXT, EXT
COUPLING	AC

Storage

STORE/NON-STORE	NON-STORE
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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), on the 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 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 a display amplitude of 4 divisions.

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 a display amplitude of 4 divisions.

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 the CH 1 and CH 2 Vertical Magnification to X10 (pull CAL knobs out).

k. ADJUST—CH 2 X10 Gain (R162) for a display amplitude of 4 divisions.

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 a display amplitude of 4 divisions.

5. Check Deflection Accuracy and VOLTS/DIV Variable Range

a. SET:

VOLTS/DIV Variable (both)	CAL detent
Vertical Magnification (both)	X1 (CAL knobs in)

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 2 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 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 CH 2 controls.

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

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 CH 2 AC-GND-DC switch to AC.

e. CHECK—that the display is centered about the center horizontal graticule line.

f. Set the CH 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 CH 1 controls.

7. Check Position Range

a. SET:

VOLTS/DIV (both)	10 mV
AC-GND-DC (both)	AC
SEC/DIV	0.2 ms
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 the CH 1 VOLTS/DIV to 5 mV.

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

f. CHECK—that 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 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 CH 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
VOLTS/DIV Variable (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 Vertical Magnification (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 CH 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 DC
AC-GND-DC (both)	DC

b. Connect the high-amplitude, square-wave output from the calibration generator via a 50- Ω BNC termination, a probe-tip-to-BNC adapter, and the 10X probe to the CH 2 OR Y input connector.

c. Set the generator to produce a 5-division display at 1 kHz 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 5-division display.

f. ADJUST—Trimmer 1 for flattest response on the square wave signal. See figure 5-1 for location of the trimmers.

g. Replace the 50- Ω BNC coaxial cable and 50- Ω BNC termination with the probe and probe-tip-to-BNC adapter.

h. Set the generator to produce a 5-division square wave.

i. ADJUST—Trimmer 1N for flattest response on square wave.

j. Set the CH 2 VOLTS/DIV switch to 20 mV.

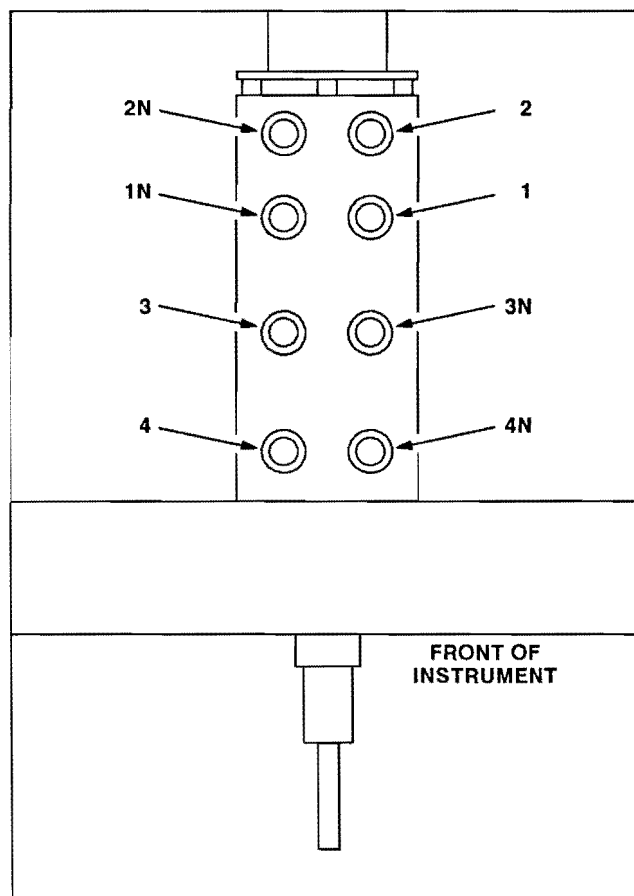


Figure 5-1. Attenuator trimmer adjustments.

k. Repeat Parts d through i except adjust the "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 the "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 the "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 the CH 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 CH 1 and CH 2 traces about 2 divisions apart using the CH 1 and CH 2 POSITION controls.

c. CHECK—CH 1 and CH 2 traces move across the screen alternately.

11. Check CHOP Operation

a. SET:

Vertical MODE	BOTH, NORM, and CHOP
SEC/DIV	1 μ s
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
AC-GND-DC (both)	DC
Vertical MODE	BOTH, NORM, and ALT
SEC/DIV	0.5 ms
Horizontal MAG	X1
Trigger SOURCE	CH 1

b. Position both traces on the center horizontal graticule line using the CH 1 and CH 2 POSITION controls.

c. Set the calibration generator to produce a 50-mV signal.

d. Connect the output of the calibration generator to both the CH 1 OR X input and the CH 2 OR Y input with 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 $\pm$ 3% (4.85 to 5.15 divisions).

h. Disconnect the test equipment from the instrument.

13. Adjust High-Frequency Compensation

a. SET:

VOLTS/DIV (both)	10 mV Vertical
MODE	CH 1
SEC/DIV	0.2 μ s

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 5-division display at 1 MHz.

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 to 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 switch to 5 mV.

j. Set the generator for a 5-division signal.

k. CHECK—for aberrations of $\pm$ 6% (0.3 division) or less.

l. Set the CH 1 VOLTS/DIV switch to 10 mV.

m. Set the generator for a 5-division signal.

n. CHECK—for aberrations of $\pm 4\%$ (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 5-division display at each VOLTS/DIV switch setting.

NOTE

Some generators do not produce enough signal amplitude to do parts p through t.

p. Set the CH 1 VOLTS/DIV switch to 0.5 V.

q. CHECK—for aberrations of $\pm 6\%$ (0.3 division) or less.

r. Set the CH 1 VOLTS/DIV switch to 1 V.

s. CHECK—for aberrations of $\pm 12\%$ (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 5-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 f through t for CH 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 μ s
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, 6-division display.

d. Increase the sine-wave 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 ranges from 10 mV to 0.5 V.

g. SET:

CH 1 VOLTS/DIV	5 mV
CH 1 VOLTS/DIV Variable	X10 (CAL knob out)

h. Set the generator to produce a 50-kHz, 6-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 0.5 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 l for CH 2.

15. Check Channel Isolation

a. SET:

CH 1 VOLTS/DIV	0.5 V
CH 2 VOLTS/DIV	1 V
CH 1 AC-GND-DC	GND
CH 2 AC-GND-DC	DC
SEC/DIV	0.05 μ s

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. 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 a dual-input coupler to the CH 1 OR X and CH 2 OR Y input connectors.

c. Set the generator to produce a 6-division display at 20 MHz.

d. Set Vertical MODE to BOTH, CH 2 INVERT, and ADD.

e. CHECK—that the ADD display 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)
Screwdriver (Item 6)	Low-Reactance Alignment tool (Item 16)

See **ADJUSTMENT LOCATIONS** at the back of this manual for adjustment locations.

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 ($\neg$)
LEVEL	Midrange
MODE	P-P AUTO
HOLD OFF	MIN
SOURCE	CH 1
COUPLING	AC

Storage

STORE/NON-STORE	NON-STORE
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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 1 marker per division over the center 8 divisions.

2. Adjust Magnifier Gain (R731, R777)

a. Set Horizontal MAG to 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 controls.

d. ADJUST—X10 Mag Gain (R777) for 1 marker per division.

e. Set the time-mark generator for 20- μ s time markers.

f. ADJUST—X50 Mag Gain (R731) for 1 marker per division.

3. Adjust Magnifier Registration (R730, R782)

- a. Set the Horizontal MAG to X10 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 X1.
- d. ADJUST—X10 Mag Reg (R782) to bring first time marker to the center vertical graticule line.
- e. Set Horizontal MAG to X50.
- f. ADJUST—X50 Mag Reg (R730) to overlay the first time marker to 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 control.
- 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 divisions.

6. Check Variable Range

- a. Select 0.5-ms time markers from the time-mark generator.
- b. Set the SEC/DIV Variable control knob fully counterclockwise

- c. CHECK—that the spacing between time markers is 2 divisions or less.

- d. Return the SEC/DIV Variable knob to the CAL detent.

7. Adjust 10- μ s and 5- μ s Timing (R722, C703)

- a. Set the SEC/DIV switch to 10 μ s.
- b. Select 10- μ s time markers from the time-mark generator.
- c. ADJUST—10- μ s Timing (R722) for 1 marker per division.
- d. Set the SEC/DIV switch to 5 μ s.
- e. Select 5- μ s time markers from the time-mark generator.
- f. ADJUST—5- μ s Timing (C703) for 1 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 μ s
Horizontal MAG	X10
Trigger SOURCE	EXT, EXT

- b. Select 10-ns time markers from the time-mark generator.
- c. Connect the time-mark generator trigger output via a 50- Ω BNC coaxial cable and a 50- Ω BNC termination to the EXT INPUT OR Z input connector.
- d. Adjust the Trigger LEVEL control so that the markers are stably triggered.
- e. ADJUST—5-ns Linearity (C784) and 5-ns Timing (C794) for 2 divisions between each marker.

9. Check Timing Accuracy and Linearity

- a. SET:

CH VOLTS/DIV	0.5 V
SEC/DIV	0.05 μ s
Horizontal MAG	X1

- b. Select 50-ns time markers from the time-mark generator.

c. Adjust the Trigger LEVEL control for a stable, triggered display.

d. Use the Horizontal POSITION control to align the second time marker with the second vertical graticule line.

e. CHECK—timing accuracy is within 3% (0.24 division at the 10th vertical graticule line) and linearity is within 5% (0.10 division over any 2 of the center 8 divisions).

NOTE

When checking the timing accuracy for 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 control.

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

With X50 magnification, in all "2" decade switch settings the associated time-marker settings give only 5 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 μ s
Horizontal MAG	X10

i. Select 10-ns time markers from the time-mark generator.

j. Use the Horizontal POSITION control to align the first time marker that is 50 ns beyond the start of the sweep with the 2nd vertical graticule line.

k. CHECK—timing accuracy is within 4% (0.32 division at the 10th vertical graticule line), and linearity is

within 7% (0.14 division over any 2 of the center 8 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 Magnified column.

m. SET:

SEC/DIV	0.5 μ s
Horizontal MAG	X50

n. Select 10-ns time markers from the time-mark 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 2 of the center 8 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 Magnified column.

r. Disconnect the test equipment from the instrument.

10. Adjust X-Y Gain and Offset (R395, R736)

a. SET:

VOLTS/DIV (both)	10 mV
SEC/DIV	X-Y (fully ccw)
Horizontal MAG	X1

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—X Gain (R395) for exactly a 5-division display.

d. Center the display within the graticule using the CH 1 POSITION control.

Table 5-4
Settings for Timing Accuracy Checks

SEC/DIV Switch Setting	Time-Mark Generator Setting		
	Normal (X1)	X10 Mag	X50 Mag
0.05 μ s	50 ns		
0.1 μ s	0.1 μ s	10 ns	
0.2 μ s	0.2 μ s	20 ns	10 ns
0.5 μ s	0.5 μ s	50 ns	10 ns
1 μ s	1 μ s	0.1 μ s	20 ns
2 μ s	2 μ s	0.2 μ s	0.1 μ s
5 μ s	5 μ s	0.5 μ s	0.1 μ s
10 μ s	10 μ s	1 μ s	0.2 μ s
20 μ s	20 μ s	2 μ s	1 μ s
50 μ s	50 μ s	5 μ s	1 μ s
0.1 ms	0.1 ms	10 μ s	2 μ s
0.2 ms	0.2 ms	20 μ s	10 μ s
0.5 ms	0.5 ms	50 μ s	10 μ s
1 ms	1 ms	0.1 ms	20 μ s
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

e. SET:

CH 1 AC-GND-DC
SEC/DIV

GND
1 ms

f. Align the start of the trace with the first (extreme left) vertical graticule line using the Horizontal POSITION control.

g. Set the SEC/DIV switch to X-Y (fully counterclockwise).

h. ADJUST-X Centering (R736) to position the spot at the center vertical graticule line.

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 8-division horizontal display at an output frequency of 50 kHz.

d. Increase the signal 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 on the Attenuator circuit board.

c. Set HOLDOFF control fully counterclockwise (MIN setting).

d. Measure the HOLDOFF time.

e. Rotate the HOLDOFF control to the fully clockwise position

f. CHECK—sweep holdoff time has increased by at least a factor of 8 times.

g. Repeat Parts c through f for SEC/DIV settings of 0.5 ms and 5 μ s.

h. Disconnect the 10X probe from R704.

TRIGGER

Equipment Required (See Table 4-1):

Leveled Sine-Wave Generator (Item 2)	Dual-Input Coupler (Item 10)
Low-Frequency Sine-Wave Generator (Item 4)	50- Ω BNC Termination (Item 11)
Screwdriver (Item 6)	600- Ω BNC Termination (Item 12)
50- Ω BNC Coaxial Cable (Item 9)	

See **ADJUSTMENT LOCATIONS** at the back of this manual for adjustment locations.

INITIAL CONTROL SETTINGS

Vertical

POSITION (both)	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 μ s
SEC/DIV Variable	CAL detent

Trigger

SLOPE	Positive ($\neg$)
LEVEL	Midrange
MODE	P-P AUTO
HOLD OFF	MIN
SOURCE	VERT MODE
COUPLING	DC

Storage

STORE/NON-STORE	NON-STORE
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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 and the CH 2 OR Y input connectors.

b. Set the generator to produce a 4-division display at 50 kHz.

c. Center the CH 1 and CH 2 traces vertically.

d. Adjust the SEC/DIV Variable 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 the 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 μ s
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 display at 50 kHz.

d. SET:

CH 1 VOLTS/DIV 1 V
Trigger MODE NORM

e. ADJUST—Trigger Sensitivity (R489) and 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 between positive (↗) and negative (↘).

g. Adjust the Trigger LEVEL control for a stable trigger.

h. Set the Trigger MODE to P-P AUTO.

i. ADJUST—P-P Offset (R478) until a stable trigger can be obtained when switching the Trigger SLOPE between positive (↗) and negative (↘).

3. Check Trigger Sensitivity

a. SET:

CH 1 VOLTS/DIV 0.1 V
CH 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 3-division display at 5 MHz.

c. Set the CH 1 VOLTS/DIV switch to 1 V.

d. CHECK—a stable display can be obtained by adjusting the Trigger LEVEL control for each switch combination given in Table 5-5. 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.

Table 5-5

Switch Combinations for Triggering Checks

Trigger MODE	Trigger SLOPE
NORM	Positive ↗
NORM	Negative ↘
P-P AUTO	Positive ↗
P-P AUTO	Negative ↘

f. Repeat part d.

g. 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 1.

h. Repeat Part d.

i. Disconnect the test equipment from the instrument.

j. SET:

CH 1 VOLTS/DIV 20 mV
Vertical MODE CH 1
SEC/DIV 0.2 μs
Trigger MODE P-P AUTO
Trigger SOURCE EXT, EXT

k. Connect the leveled sine-wave generator output via 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.

l. Set the generator to produce a 4-division (80 mV) display at 5 MHz.

m. Repeat Part d.

n. 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 sine-wave 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 1-division display at 20 Hz.

d. CHECK—for stable triggering in both positive ($\nearrow$) and negative ($\searrow$) slope. Ensure that the TRIG'D light comes on when triggered.

5. Adjust External Trigger Offset and Range

a. SET:

CH 1 VOLTS/DIV	0.5 V
CH 1 AC-GND-DC	DC
Vertical MODE	CH 1
SEC/DIV	20 μ s
Trigger MODE	P-P AUTO
Trigger SOURCE	CH 1
Trigger COUPLING	AC
Trigger SLOPE	Positive ($\nearrow$)

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 the EXT INPUT OR Z input connectors.

c. Set the leveled sine-wave generator to produce a 5-division display at 50-kHz.

d. Position the waveform equally about the center horizontal graticule line.

e. SET:

Trigger MODE	NORM
Trigger SOURCE	EXT, EXT

f. ADJUST—Ext Trig Offset (R360) so that the trace is untriggered at either end of the Trigger LEVEL control.

g. Set the Trigger COUPLING switch to DC.

h. CHECK—that the display can be untriggered at either end of the Trigger LEVEL control.

i. Set the Trigger SOURCE switch to $\frac{\text{EXT}}{10}$

j. CHECK—that the display can be triggered about the midrange of the Trigger LEVEL control.

k. Set the Trigger SLOPE switch to negative ($\searrow$) and repeat Part j.

l. Disconnect the test equipment from the instrument.

6. 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 ($\nearrow$)

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 in the SGL SWP RESET button. The READY light should turn on and remain lit.

f. Set the CH 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 the SGL SWP RESET button several times.

i. CHECK—a single-sweep trace occurs and the READY light turns on briefly each 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)
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

CH 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
HORIZONTAL MAG	X1
SEC/DIV	20 ms SEC/DIV
Variable	CAL detent

Trigger

SLOPE	Positive (↗)
LEVEL	Midrange
MODE	P-P AUTO
HOLD OFF	MIN
SOURCE	EXT, EXT = Z
COUPLING	DC

Storage

STORE/NON-STORE	NON-STORE
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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 BNC termination, and a dual-input coupler to the CH 1 OR X and the EXT INPUT OR Z input connectors.

b. Set the generator to produce a 5-division display at 50-kHz.

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)	Dual-Input Coupler (Item 10)
Leveled Sine-Wave Generator (Item 2)	50- Ω BNC Termination (Item 11)
Time Mark Generator (Item 3)	600- Ω Termination (Item 12)
Low-Frequency Sine-Wave Generator (Item 4)	10X Attenuator (Item 13)
Pulse Generator (Item 5)	2X Attenuator (Item 14)
50- Ω BNC Coaxial Cable (Item 9)	DAC Cal Fixture (Item 18)

See **ADJUSTMENT LOCATIONS** at the back of this manual for adjustment locations.

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	0.2 ms
SEC/DIV Variable	CAL detent
MAG	X1

Trigger

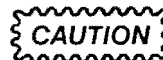
SLOPE	Positive (↗)
LEVEL	Midrange
MODE	P-P AUTO
HOLDOFF	MIN
SOURCE	EXT, EXT
COUPLING	DC

Storage

STORE/NON-STORE	STORE
PRE-TRIG 25%/75%	75%
SAVE/CONTINUE	CONTINUE
REFERENCE POSITION	Midrange

PROCEDURE STEPS

1. Adjust Vertical DAC (R2513, R2509)



The DAC CAL fixture is not keyed to prevent it from being plugged on to P2007 incorrectly. The component side of the fixture must be on the top side of the fixture when plugged in.

a. Turn off the oscilloscope and connect the DAC Cal fixture (067-1373-00) to P2007 on the storage board.

b. Turn the instrument back on and check that 4 horizontal lines appear on the screen.

c. ADJUST—Vertical Offset (R2513) to set the 2 middle traces to the horizontal graticule lines immediately above and below the top and bottom horizontal graticule lines.

d. ADJUST—Vertical Gain (R2509) to align the outer two traces to the horizontal graticule lines immediately above and below the top and bottom horizontal graticule lines.

e. CHECK—that all the traces are aligned with the horizontal graticule lines.

f. Turn off the oscilloscope and remove the DAC Cal fixture from P2007, then turn the oscilloscope on again.

2. Adjust CH 1 Storage Balance (R1016)

a. Set the STORE/NON-STORE switch 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—CH 1 Offset (R1016) on the Storage board to position the trace to the center horizontal graticule line.

3. Adjust CH 1 Storage Gain (R1001)

a. SET:

CH 1 AC-GND-DC	DC
Trigger SOURCE	CH 1

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—CH 1 Offset (R1001) on the Storage board for a display amplitude of exactly 4 divisions peak-to-peak.

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. Position the trace to the center horizontal graticule, using the CH 2 POSITION control.

c. Set the STORE/NON-STORE switch to STORE.

d. ADJUST—CH 2 Offset (R1017) on the Storage Board to position the trace to the center horizontal graticule line.

5. Adjust CH 2 Storage Gain (R1004)

a. SET:

CH 2 AC-GND-DC	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—CH 2 Gain (R1004) on the Storage board for a display amplitude of exactly 4 divisions peak-to-peak.

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 the STORE/NON-STORE switch to STORE.

d. ADJUST—ADD Offset (R1036) until the trace is positioned on the center horizontal graticule line.

7. Adjust Add Storage Gain (R1040)

a. SET:

Vertical MODE	CH 2 INVERT
AC-GND-DC (both)	DC
Trigger SOURCE	CH 1

b. Connect a 20-mV, standard-amplitude signal from the calibration generator via 50- Ω BNC coaxial cable and a dual-input coupler to the CH 1 OR X and Ch 2 OR Y inputs.

c. ADJUST—ADD Gain (R1040) on the Storage Board until the trace is flat (no square-wave amplitude).

d. Disconnect the test equipment from the instrument.

8. Adjust Display Glitch (C2500)

a. SET:

Vertical MODE	CH 1, NORM
CH 1 VOLTS/DIV	0.1 V
SEC/DIV	1 ms

b. Connect a 20-Hz signal from the low-frequency sine-wave generator via a 50- Ω BNC coaxial cable and a 600- Ω termination to the CH 1 OR X input

c. Adjust the sine-wave generator for a displayed amplitude of 6 divisions peak-to-peak.

d. ADJUST—Glitch Nul (C2500) on the Storage board until the digital noise glitch is at a minimum.

e. Disconnect the test equipment from the instrument.

9. 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 $\pm 3\%$ (3.88 to 4.12 divisions).

f. Select each VOLTS/DIV setting and corresponding standard-amplitude signal level given to 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 5-5.

h. Set the calibration generator standard-amplitude output to 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

k. Repeat parts c through g for CH 2.

l. Disconnect the test equipment from the instrument.

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

10. Check Store ADD Mode**a. SET:**

Vertical MODE	BOTH, ADD, NORM
SEC/DIV	0.2 ms
VOLTS/DIV (both)	20 mV
STORE/NON-STORE	NON-STORE

b. Set the calibration generator to output a 50-mV, standard-amplitude signal and connect it via a dual-input coupler to the CH 1 OR X and CH 2 OR Y inputs.

c. Position the display around the center horizontal graticule line.

d. CHECK—that the displayed signal amplitude is between 4.85 and 5.15 divisions peak-to-peak.

e. Set the STORE/NON-STORE switch to STORE.

f. CHECK—that the displayed signal amplitude is between 4.85 and 5.15 divisions peak-to-peak.

g. Disconnect the test equipment from the instrument.

11. Check Storage Bandwidth**a. SET:**

VOLTS/DIV (both)	5 mV
Vertical MODE	CH 1
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, 6-division display.

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 sine-wave frequency until a 4.2-division display is obtained.

e. CHECK—that the test-signal frequency is greater than 10 MHz.

f. Repeat parts c through e for all CH 1 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. Repeats parts c through e for all CH 2 VOLTS/DIV settings from 5 mV to 0.5 V.

12. Check Store Mode Channel Isolation**a. SET:**

CH 1 VOLTS/DIV	1 V
CH 2 AC-GND-DC	GND
CH 2 VOLTS/DIV	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:

CH 1 VOLTS/DIV	0.5 V
Vertical MODE	CH 2

f. CHECK—that the displayed signal amplitude is less than 0.1 division.

g. Move the test signal to the CH 2 input.

h. SET:

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

i. CHECK—that the displayed signal amplitude is less than 0.1 division.

j. Disconnect the test equipment from the instrument.

13. 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 BNC termination, and a dual-input coupler to the CH 1 OR X and the CH 2 OR Y inputs.

c. Set the generator output for a 6-division display amplitude.

d. Set Vertical MODE to CH 2 INVERT, ADD, BOTH.

e. Increase the signal frequency to 10 MHz.

f. CHECK—that the ADD display amplitude is less than 0.6 division.

g. Disconnect the test equipment from the instrument.

14. Check Display and Save Ref

a. SET:

Vertical MODE	CH 1
CH 1 AC-GND-DC	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 from 0 to 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 trigger point on the CH 1 trace changes, but that the trigger point on the Reference trace remains the same.

k. Press Display ON/OFF to turn off the Reference trace.

15. Check SAVE/CONTINUE

a. Position the CH 1 trace on the center horizontal graticule using the CH 1 POSITION control.

b. Press SAVE/CONTINUE switch to SAVE.

c. CHECK—that the trace cannot be moved vertically using the CH 1 Vertical POSITION control.

d. Press SAVE/CONTINUE switch to CONTINUE.

e. CHECK—that the trace can be moved using the CH 1 Vertical POSITION control.

16. 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.

17. Check Single Sweep

a. SET:

CH 1 VOLTS/DIV	0.5 V
CH 1 AC-GND-DC	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 TRIG'D/READY indicator has gone out, the display should be stopped.

h. Press the SGL SWP RESET button.

i. CHECK—that the display clears and the TRIG'D/READY indicator does not light until the pre-trigger data (the first 25% of the trace) is acquired.

j. Disconnect the test equipment from the instrument.

18. 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 the CH 1 OR X and the CH 2 OR 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	0.1 s
Trigger MODE	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 the signal is reconnected to the CH 1 input.

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 the signal is reconnected to the CH 2 input.
- q. Set Vertical MODE to CHOP.
- r. Press the SGL SWP RESET button.
- s. CHECK—that both channels are displayed.
- t. Disconnect the test equipment from the instrument.

19. Check External Clock Record Mode

- a. SET:

Vertical MODE	CH 1, ALT
SEC/DIV	EXT CLK
Trigger MODE	P-P AUTO
Trigger SOURCE	CH 1

b. Connect a 0–5 V, 10-MHz symmetrical square wave 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- μ 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.

- d. Set the SAVE/CONTINUE switch to SAVE.

e. CHECK—that the displayed signal has 2 markers per division.

f. Disconnect the test equipment from the oscilloscope.

20. Check External Clock Roll Mode

- a. Set the SAVE/CONTINUE switch to CONTINUE.

b. Turn the Horizontal Variable control (CAL knob) fully counterclockwise.

c. Connect a 0–5 V, 4-kHz symmetrical square wave 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 the SAVE/CONTINUE switch to SAVE.

f. CHECK—that the displayed signal has 1 marker per division.

g. Return the Horizontal Variable control to the CAL detent position.

h. Disconnect the test equipment from the oscilloscope.

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.



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 all 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.

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

^aVoltage equivalent for levels (voltage discharged from a 100-pF capacitor through a 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

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.
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. Whenever the instrument is stored or is being transported, the front cover should be used.



Do not use chemical cleaning agents that 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.

INSPECTION AND CLEANING

The instrument should be visually inspected and cleaned as often as operating conditions require. Accumulation of dust in the instrument can cause overheating and component breakdown. Dust 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.

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. Any problems found that could cause personal injury or could lead to further damage to the instrument should be repaired immediately.



Do not allow moisture to get 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.

Table 6-2
External Inspection Checklist

Item	Inspect For	Repair Action
Cabinet and Front Panel	Cracks, scratches, deformations, and damaged hardware or gaskets.	Touch up paint scratches and replace defective parts.
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.
Wiring and Cables	Loose plugs or connectors. 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.

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).



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.



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 heavy black 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 are outlined with a wide grey line on the host instrument schematics. On the storage board schematics, functional blocks are outlined with a dashed 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 and Storage Board Schematic Interconnections

Several interconnection diagrams are provided in the Diagrams section to aid in tracing a signal path or power source between boards and schematics. All wire, plug, and jack numbers are shown along with their associated wire or pin numbers or the circuit board interconnection diagram. Interconnections between the various Storage board schematics must be traced using the schematic interconnection diagrams. Continuation references are not provided on the Storage board schematics as they are on the schematics for the other circuit boards of the instrument.

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 2210 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.

Storage Board Extension Cables

If the Storage board is raised for servicing, two of the ribbon cables to the Storage board must be extended to operate the oscilloscope normally. Connect the ribbon cable extenders between W1001 and W1002 (on the Main board) and J1001 and J1002 (on the Storage board) respectively.

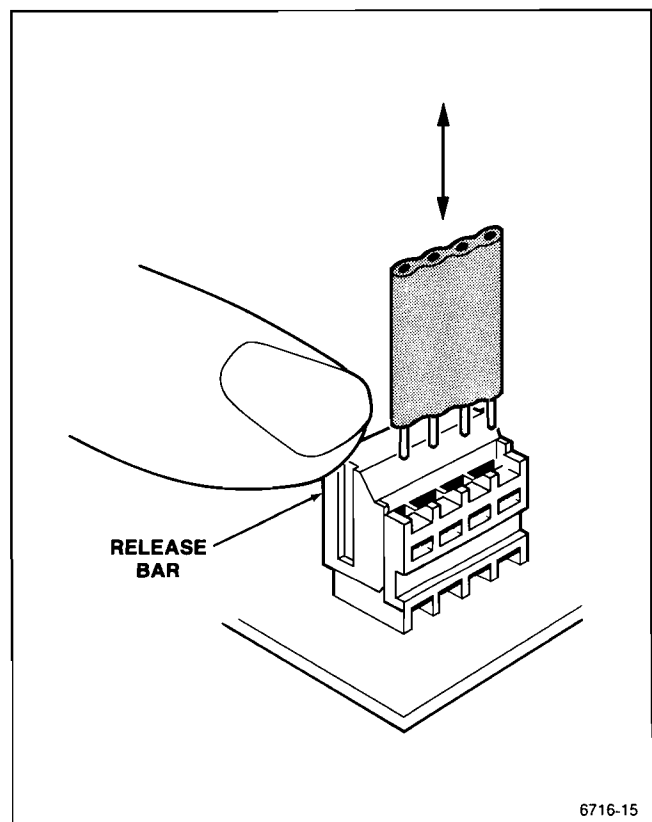


Figure 6-1. Multi-connector operation.

TROUBLESHOOTING EQUIPMENT

The test equipment listed in Table 4-1 of this manual, or equivalent equipment, may be useful when troubleshooting this instrument. The tools given in Table 6-6 are needed for assembly and disassembly of the oscilloscope and for safety (when troubleshooting the power supply).

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. Refer to the troubleshooting charts in the Diagrams section as an aid in locating a faulty circuit.

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 (see Table 6-6).

When trouble symptoms appear in more than 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 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. See the POWER SUPPLY TROUBLESHOOTING procedure for detailed troubleshooting steps for the Power Supply.

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. Changes to the control settings from the initial setup, other than those noted, are not required.

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
+8.7 V	W987	+8.526 to +8.874	30 mV
+38 V	W972	+36.86 to +39.14	30 mV
+99 V	W984	+96.03 to +101.97	175 mV

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 than 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 than 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-k Ω 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.



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-k Ω 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, Adjustments affected by repairs.

POWER SUPPLY TROUBLESHOOTING

The Power Supply is divided into four blocks: Power Input, Preregulator, 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 9) 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 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



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 the 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	80 ohms
+5.2 V	TP993	450 ohms
+5.1 V	TP991	120 ohms
+8.6 V	TP987	95 ohms
+38 V	TP972	1.1 kohms
+100 V	TP984	11 kohms

- 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 W1003 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. Lift the individual jumpers (W971, W972, W984, W985, W987, W989, W991, or W993) to isolate an indicated excessive load on a supply line to the Main board.
- f. Disconnect the H.V. lead to the high-voltage multiplier (U975) from T902 to isolate the multiplier from the Power Supply.
- g. 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 TP987.

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 220 mV. If it is more than 270 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 1.4 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.



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 to 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 HV supply lead.

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 power reservoir capacitor, C900, is discharged prior to performing any servicing on the preregulator.
3. 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 6-6 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.

INTERCONNECTIONS

Interconnections in this instrument are made with wire-trap connectors 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 connector, press down on top of the connector 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 than the rest of the cable. Be sure the index wire is aligned with the "1" when a cable is reinserted into the connector (see Figure 6-1, shown previously).

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.

Table 6-6
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 and #T15.	Assembly and disassembly.	Tektronix p/n #T9 003-0965-00 #T15 003-0966-00.
3. Nutdrivers	1/4 inch, 7/16 inch, and 1/2 inch.	Assembly and disassembly.	Xcelite #8, #14 and #16.
4. Open-end Wrench	5/16 inch and 1/2 inch.	Channel Input, EXT BNC connectors, and transformer removal.	
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. Lubricant	No-Noise. [®]	Switch lubrication.	Tektronix p/n 006-0442-02.
11. Isolation Transformer		Safety isolation for power supply trouble-shooting.	Tektronix p/n 006-5953-009.

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.

Power-supply transistor Q913 is insulated from the chassis by a heat-transferring pad and insulation bushing. Reinstall the pad and bushing 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 bend 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 and disconnect it from the ac power source.

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 circuit 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.

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 (such as isopropyl alcohol) and allow it to dry. 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 Phillips-head 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 two screws, one from the left-rear side and one from the right-rear side of the cabinet.

NOTE

There are five EMI spring clips at the rear between the cabinet and rear chassis. Note their position for reinstallation.

4. Push the rear chassis forward in the case and disengage the case locating lug from the top rear center of the chassis.
5. Pull the front panel and attached chassis forward and out of the cabinet.
6. 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. Note: reinstall the spring clips at the previously noted positions before reinstalling the rear panel.
7. Reconnect the power cord.

A10—Storage Board

The Storage board can be removed and reinstalled as follows:

1. Remove the instrument cabinet.

2. Remove the pushbuttons from the five storage switches by gently prying them off using a small flat bladed screwdriver down between the switch and the button.
3. Remove the small side panel around the EXT CLOCK connector by removing the screw just below the connector. Note the position of the grounding spring for reinstallation.
4. Remove four screws holding the Storage board to the chassis and the associated springs. See Figure 6-2.
5. Remove the remaining two springs.
6. Remove the countersunk screw located on the upper right chassis member.
7. Disconnect the two ribbon cables (J1001 and J1002) from the cable traps. See figure 6.1 for details on how to release the cables.
8. Lift the left-hand edge of the board just above the chassis rail.

NOTE

The board is now free from the chassis but is still connected to the Main board by the cables along the back edge of the Storage board.

9. Lift the front of the board, being careful not to strain the cables still attached to the rear of the board, until it is vertical. Place back edge of the upright board in the slots in the rear board-mounting brackets.
10. The Storage board can be completely removed by disconnecting the seven ribbon cables along the back edge of the board.
11. To remove the Storage board shield unsolder the resistor to the EXT CLOCK connector and remove the remaining two screws holding the shield to the storage board.
12. To reinstall the Storage board reverse above procedure, being careful to check the orientation of the cables and that the rear of the circuit board is in the board slot in the chassis cross member.

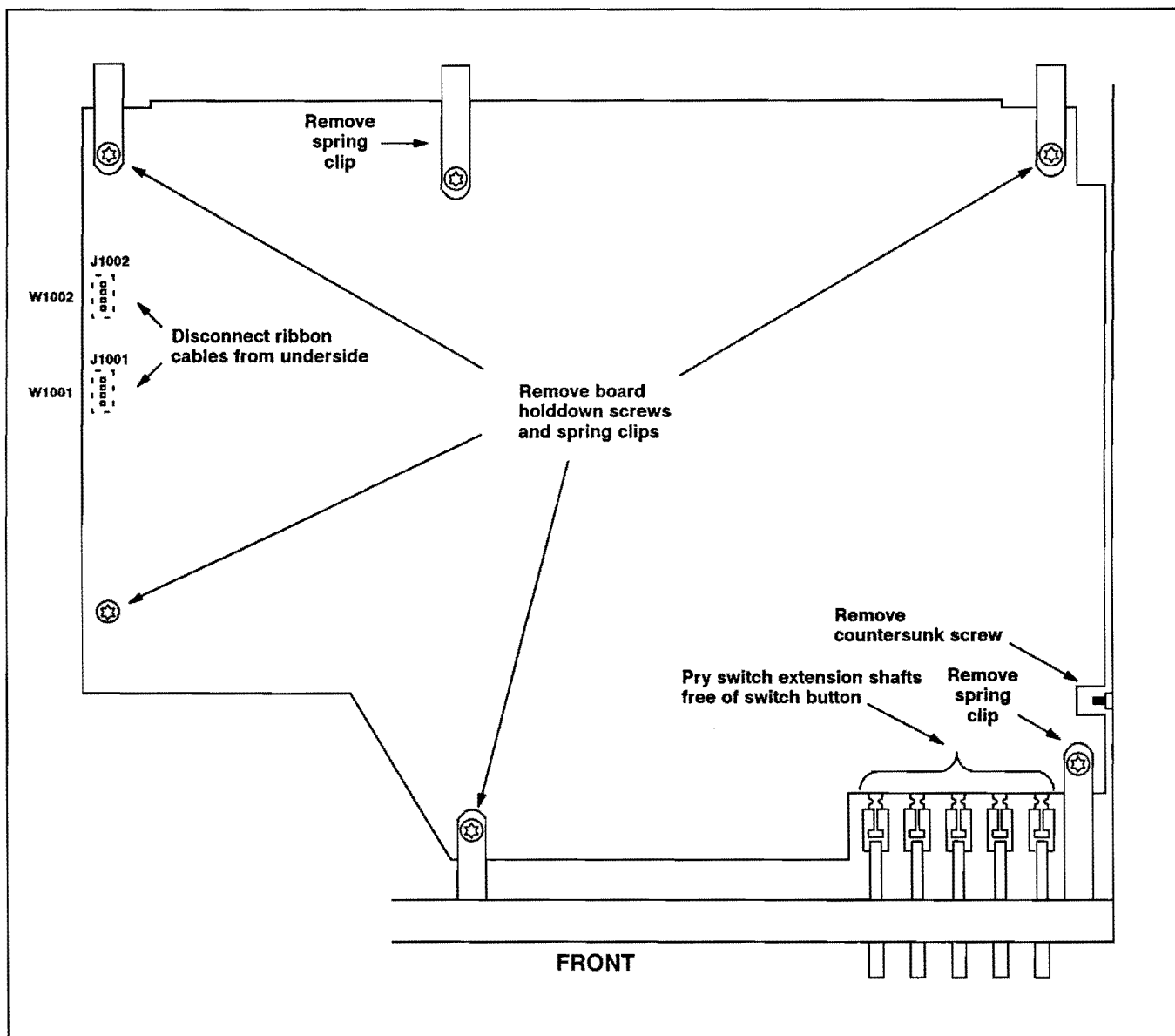


Figure 6-2. Storage board removal.

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. 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 and the High-Voltage Multiplier output lead retain a high-voltage charge after the instrument is turned off. To avoid electrical shock, unplug the crt anode lead connector from the High-Voltage 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 until it is discharged.

2. 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.
3. Remove the grounding spring from between the top of the crt funnel and front chassis.
4. 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.

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 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.
2. Disconnect connector J902 from the Mains Input board, (J902 is not polarized and can be fitted either way). Note the orientation of the Power Transformer.
3. Undo the two locking nuts from the center of the Power Transformer.
4. Supporting the Transformer, withdraw the center bolt (complete with the rear stiffening plate).

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 Power Transformer as outlined in the above section.
2. Turn the instrument over (Main board up) and unsolder the two Fan wires from the main board, taking care to note their correct location.
3. Unsolder the four power transistors from the board (Q913, Q923, Q950, and Q980).
4. Remove the two screws holding the Fan Assembly to the Main board.
5. Turn the instrument over and remove the screw holding the Fan Assembly to the top chassis member.
6. The Fan Assembly can then be removed from the instrument.
7. The Fan or the power transistors can now be unbolted from the Fan/heatsink bracket as required.

To reinstall the Fan Assembly, perform the reverse of the preceding steps.

A4—Mains Input Circuit Board

WARNING

The screw and nut which secure the Mains Input board to the inner chassis provide safety electrical grounding and must be properly replaced.

The Mains Input circuit board can be removed and reinstalled as follows:

1. Disconnect connector J902 from the Mains Input board. (J902 is not polarized so can be fitted either way).
2. Unsolder W903 from Mains Input board.
3. Disengage the Power switch extension shaft from the Mains Power switch (S901).
4. Remove the two screws and nuts that secure the AC Power inlet connector to the rear chassis.
5. Remove the grounding screw and nut that secures the Mains Input board to the inner chassis.
6. Pull the Mains Input board towards the inner chassis and up out of the instrument.

To reinstall the Mains Input 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. Turn the instrument over (Main circuit board up) and unsolder the two resistors from the CH 1 and CH 2 attenuator switches. Also unsolder the grounding straps connected between the Front Panel and the Attenuator/Timebase boards, noting their respective positions. Turn the instrument over again and continue with the Attenuator/Timebase circuit board removal procedure.
2. 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.

3. Remove the two rear screws that secure the Attenuator/Timebase board to the support pillars.
4. Remove the screw that secures the Front Panel brace to the Attenuator/Timebase board. Turn the instrument over (Main circuit board up) and remove the screw that secures the Front Panel brace pillar to the Attenuator/Timebase board.
5. Remove the Focus knob shaft by disengaging it from the Focus pot and pulling the shaft out through the front panel.
6. Disconnect the following cables from the Attenuator/Timebase circuit board, noting their locations for reinstallation reference:
 - a. J90, a six-wire cable located at the rear edge of the board.
 - b. J755, a four-wire cable located at the rear right-hand corner of the board.
 - c. J30, a four-wire cable located to the left of the CH 1 attenuator switch.
 - d. J80, a four-wire cable located between the CH 1 and CH 2 attenuator switches.
 - e. J7, a six-wire cable located between the CH 2 attenuator switch and the SEC/DIV switch.
 - f. J701, a six-wire cable located at the front right-hand corner of the board.
7. 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.

To reinstall the Attenuator/Timebase circuit board, perform the reverse of the preceding steps.

The Bottom Shield of the Attenuator/Timebase circuit board assembly can be removed by removing the two screws and nuts 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. Perform the Attenuator/Timebase Circuit board Assembly removal procedure.

2. Remove the knobs from the following control shafts by pulling them straight out from the front panel:
 - a. INTENSITY.
 - b. CH 1 and CH 2 POSITION.
 - c. REFERENCE POSITION.
 - d. COARSE and FINE Horizontal POSITION controls.
 - e. LEVEL.
 - f. HOLDOFF.
3. Unsolder both the resistor (R382) to the EXT INPUT center connector and the wire strap to the EXT INPUT OR Z ground lug.
4. Unsolder the resistors and wire straps to the CH 1 OR X and CH 2 OR Y input connectors.
5. Unsolder the Trace Rotation wires (J987) from the Front-Panel circuit board (note the connection locations and wire colors for reinstallation reference).
6. Remove the Power Switch extension shaft by disengaging from power switch and pulling it out through the Front Panel.
7. Remove the focus shaft by pulling it out through the front panel, and disconnect the following cables from the Storage board:
 - a. J1009, a six-way cable located second from the right on the Storage board.
 - b. J1010, a six-way cable located third from the right on the Storage board.
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. Disconnect J7 from the front panel and attenuator.
10. Remove the five screws that secure the Front Panel board to the front chassis, noting their respective positions.

11. Withdraw the Front Panel circuit board from the front chassis taking care not to lose the slider switch covers.

To reinstall the Front-Panel circuit board, perform the reverse of the preceding steps.

A1—Main Circuit Board

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 and inner chassis can be removed and reinstalled together 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 (see instructions on page 6-20). Disengage the HV Multiplier connector from the clip located on the inner chassis.
2. Remove the focus shaft by pulling it through the front panel.
3. Unsolder W903 from the rear of the Mains Input board.
4. Disengage the following cables from their respective wire-trap connectors located on the Attenuator/Timebase board:
 - a. J755, four-wire cable located at rear right corner of board.
 - b. J90, six-wire cable located at center rear edge of board.
 - c. J30, four-wire cable located at the left hand side of the CH 1 attenuator switch.
 - d. J80, four-wire cable located between the CH 1 and CH 2 attenuator switches.
 - e. J701, six-wire cable located at front right corner of board.

5. Turn instrument upside down (bottom of Main board facing up) with the rear of the instrument facing you.
 6. Remove the two screws that secure the heatsink for the vertical output transistors (Q256 and Q257) to the rear chassis.
 7. Remove the screw that secures the heatsink for the power supply transistors (Q950, Q980, Q923, and Q913) to the rear chassis.
 8. With the instrument still upside down, rotate it so that the front is facing you. Unsolder the wire connected to the Probe Adjust terminal from the Main board.
 9. Disconnect the following cables from their respective wire-trap connectors located along the front edge of the Main board: J1, J2, J3, J4, J5, and J6.
 10. Remove the three screws that secure the Main board to the pillars of the Attenuator/Timebase assembly.
 11. Remove the two screws and nuts that secure the Main board to the left hand chassis member.
 12. Remove the three screws and nuts that secure the Main board to the right hand chassis member.
 13. Remove the four screws that secure the inner chassis.
 14. Remove the nut and screw that secure the inner chassis to the Mains Input board.
 15. Lift out Main board and 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 AND ACCESSORIES

INTRODUCTION

This section lists the standard accessories (including Tektronix part numbers) that are shipped with each instrument. It also briefly describes the options that can be included with the original instrument order. If you wish to obtain any of these options after receiving your instrument, use the accessories lists contained in Tables 7-1 and 7-2. For additional information about instrument options and other optional accessories, consult the current Tektronix Product Catalog or contact your local Tektronix Sales Office or distributor.

STANDARD ACCESSORIES

Each instrument is shipped with the following standard accessories.

Quantity	Description	Part Number
2	Probes, 10X, 2 m, with accessories	P6103
1	Operator's Manual	070-6847-00
1	User's Reference Guide	070-6898-00
1	Power Cord and Fuse	Per option ordered; see Table 7-1
1	Power-cord Clamp	343-0003-00
1	Screw	213-0882-00
1	Washer	210-0803-00

OPTIONS

Option 02

This option is intended for users who need added front-panel protection and accessories-carrying ease

demanding 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.

Option 1C

An oscilloscope camera is useful for capturing single events and documenting measurement results. And it helps communicate results with clarity and credibility. Option 1C provides the Tektronix C-5C Option 04 Low-cost Camera for use with your oscilloscope.

Option 1K

When this option is specified, a K212 Portable Instrument Cart is included in the shipment. The cart provides a stable yet movable platform that is well suited for on-site instrument mobility in a variety of work areas.

Option 1R

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 main frame.

Complete rack-mounting 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 orderable rack-mounting conversion kit.

Option 23

Two P6062B 1X-10X Selectable-attenuation Probes are provided in place of the standard P6103 10X Probes.

Power Cords

Instruments are shipped with the detachable power cord and fuse configuration ordered by the customer. Table 7-1 identifies the Tektronix part numbers for international power cords and associated fuses. Additional informa-

tion about power cord options is contained in Section 1, Preparation for Use.

Optional Accessories

Table 7-2 lists recommended optional accessories for your instrument.

Table 7-1
Power Cords and Fuses

Description	Part Number
Standard (United States)	
Power Cord, 2.5 m	161-0104-00
Fuse, 1.0 A, 250 V, 3AG, 1/4" x 1 1/4", Slow	159-0019-00
Option A1 (Europe)	
Power Cord, 2.5 m	161-0104-06
Fuse, 0.5 A, 250 V, 3AG, 1/4" x 1 1/4", Slow	159-0032-00
Option A2 (United Kingdom)	
Power Cord, 2.5 m	161-0104-07
Fuse, 0.5 A, 250 V, 3AG, 1/4" x 1 1/4", Slow	159-0032-00
Option A2 (Australia)	
Power Cord, 2.5 m	161-0104-05
Fuse, 0.5 A, 250 V, 3AG, 1/4" x 1 1/4", Slow	159-0032-00
Option A2 (North America)	
Power Cord, 2.5 m	161-0104-08
Fuse, 0.5 A, 250 V, 3AG, 1/4" x 1 1/4", Slow	159-0032-00
Option A2 (Switzerland)	
Power Cord, 2.5 m	161-0167-00
Fuse, 0.5 A, 250 V, 3AG, 1/4" x 1 1/4", Slow	159-0032-00

Table 7-2
Optional Accessories

Description	Part Number
Front Panel Protective Cover	200-3397-00
Accessory Pouch	016-0677-02
Front Panel Protective Cover and Accessory Pouch	020-1514-00
Hand Carrying Case	016-0792-01
CRT Light Filter, Clear	337-2775-01
Rack Mount Conversion Kit	016-0819-00
Viewing Hoods	
Collapsible	016-0592-00
Polarised	016-0180-00
Binocular	016-0566-00
Alternative Power Cords	
European	020-0859-00
United Kingdom	020-0860-00
Australian	020-0861-00
North American	020-0862-00
Swiss	020-0863-00
Attenuator Voltage Probes	
10X Standard	P6103
10X Subminiature	P6130
10X Environmental	P6008
1X-10X Selectable	P6062B
100X High Voltage	P6009
1000X High Voltage	P6015
Current Probes	P6021, P6022, A6302/AM503, A6303/AM503
Current-Probe Amplifier	134
Active Probe, 10X FET	P6202A
Active-probe Power Supply	1101A
Ground Isolation Monitor	A6901
Isolator (for multiple, independently referenced, differential measurements)	A6902B
DC Inverter	1107
DC Inverter Mounting Kit	016-0785-00

Table 7-2 (cont)

Description	Part Number
Portable Power Supply	1105
Battery Pack	1106
Oscilloscope Cameras Low-cost Motorized	C-5C Option 04 C-7 Option 03 and Option 30
Portable Instrument Cart	K212
2210 Service Manual	070-6848-00

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

LIST OF ASSEMBLIES

A list of assemblies can be found at the beginning of the Electrical Parts List. The assemblies are listed in numerical order. When the complete component number of a part is known, this list will identify the assembly in which the part is located.

CROSS INDEX-MFR. CODE NUMBER TO MANUFACTURER

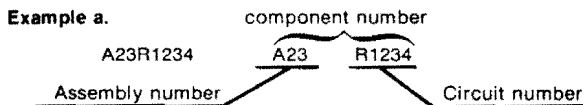
The Mfr. Code Number to Manufacturer index for the Electrical Parts List is located immediately after this page. The Cross Index provides codes, names and addresses of manufacturers of components listed in the Electrical Parts List.

ABBREVIATIONS

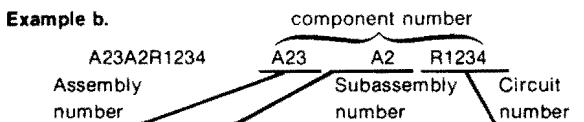
Abbreviations conform to American National Standard Y1.1.

COMPONENT NUMBER (column one of the Electrical Parts List)

A numbering method has been used to identify assemblies, subassemblies and parts. Examples of this numbering method and typical expansions are illustrated by the following:



Read: Resistor 1234 of Assembly 23



Read: Resistor 1234 of Subassembly 2 of Assembly 23

Only the circuit number will appear on the diagrams and circuit board illustrations. Each diagram and circuit board illustration is clearly marked with the assembly number. Assembly numbers are also marked on the mechanical exploded views located in the Mechanical Parts List. The component number is obtained by adding the assembly number prefix to the circuit number.

The Electrical Parts List is divided and arranged by assemblies in numerical sequence (e.g., assembly A1 with its subassemblies and parts, precedes assembly A2 with its subassemblies and parts).

Chassis-mounted parts have no assembly number prefix and are located at the end of the Electrical Parts List.

TEKTRONIX PART NO. (column two of the Electrical Parts List)

Indicates part number to be used when ordering replacement part from Tektronix.

SERIAL/MODEL NO. (columns three and four of the Electrical Parts List)

Column three (3) indicates the serial number at which the part was first used. Column four (4) indicates the serial number at which the part was removed. No serial number entered indicates part is good for all serial numbers.

NAME & DESCRIPTION (column five of the Electrical Parts List)

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

MFR. CODE (column six of the Electrical Parts List)

Indicates the code number of the actual manufacturer of the part. (Code to name and address cross reference can be found immediately after this page.)

MFR. PART NUMBER (column seven of the Electrical Parts List)

Indicates actual manufacturers part number.

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
00853	SANGAMO WESTON INC	SANGAMO RD	PICKENS SC 29671-9716
	COMPONENTS DIV	PO BOX 128	
01121	ALLEN-BRADLEY CO	1201 S 2ND ST	MILWAUKEE WI 53204-2410
01281	MOTOROLA INC	14520 AVIATION BLVD	LAWDALE CA 90260-1121
	RF & OPTOELECTRONIC PRODUCTS DIV		
01295	TEXAS INSTRUMENTS INC	13500 N CENTRAL EXPY	DALLAS TX 75265
	SEMICONDUCTOR GROUP	PO BOX 655012	
01537	MOTOROLA	2553 N EDGINGTON ST	FRANKLIN PARK IL 60131-3401
	COMMUNICATIONS AND ELECTRONICS INC		
02114	AMPEREX ELECTRONIC CORP	5083 KINGS HWY	SAUGERTIES NY 12477
	FERROXCUBE DIV		
02735	RCA CORP	ROUTE 202	SOMERVILLE NJ 08876
	SOLID STATE DIVISION		
03508	GENERAL ELECTRIC CO	W GENESEE ST	AUBURN NY 13021
	SEMI-CONDUCTOR PRODUCTS DEPT		
04222	AVX CERAMICS	19TH AVE SOUTH	MYRTLE BEACH SC 29577
	DIV OF AVX CORP	P O BOX 867	
04426	LICON	6615 W IRVING PARK RD	CHICAGO IL 60634-2410
	DIV OF ILLINOIS TOOL WORKS INC		
04713	MOTOROLA INC	5005 E MCDOWELL RD	PHOENIX AZ 85008-4229
	SEMICONDUCTOR PRODUCTS SECTOR		
05397	UNION CARBIDE CORP	11901 MADISON AVE	CLEVELAND OH 44101
	MATERIALS SYSTEMS DIV		
05828	GENERAL INSTRUMENT CORP	600 W JOHN ST	HICKSVILLE NY 11802
	GOVERNMENT SYSTEMS DIV		
06665	PRECISION MONOLITHICS INC	1500 SPACE PARK DR	SANTA CLARA CA 95050
	SUB OF BOURNS INC		
07263	FAIRCHILD SEMICONDUCTOR CORP	10400 RIDGEVIEW CT	CUPERTINO CA 95014
	NORTH AMERICAN SALES		
	SUB OF SCHLUMBERGER LTD MS 118		
07716	TRW INC	2850 MT PLEASANT AVE	BURLINGTON IA 52601
	TRW IRC FIXED RESISTORS/BURLINGTON		
09353	C AND K COMPONENTS INC	15 RIVERDALE AVE	NEWTON MA 02158-1057
12954	MICROSEMI CORP - SCOTTSDALE	8700 E THOMAS RD	SCOTTSDALE AZ 85252
		P O BOX 1390	
12969	UNITRODE CORP	5 FORBES RD	LEXINGTON MA 02173-7305
13511	AMPHENOL CADRE		LOS GATOS CA
	DIV BUNKER RAMO CORP		
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
15238	ITT SEMICONDUCTORS	500 BROADWAY	LAWRENCE MA 01841-3002
	A DIVISION OF INTERNATIONAL	PO BOX 168	
	TELEPHONE AND TELEGRAPH CORP		
15454	AMETEK INC	721 N POPLAR ST	ORANGE CA 92668
	RODAN DIV		
18324	SIGNETICS CORP	4130 S MARKET COURT	SACRAMENTO CA 95834-1222
	MILITARY PRODUCTS DIV		
18796	MURATA ERIE NORTH AMERICAN INC	1900 W COLLEGE AVE	STATE COLLEGE PA 16801-2723
	STATE COLLEGE OPERATIONS		
19396	ILLINOIS TOOL WORKS INC	1205 MCCONVILLE RD	LYNCHBURG VA 24502-4535
	PAKTRON DIV	PO BOX 4539	
19701	MEPCO/CENTRALAB	PO BOX 760	MINERAL WELLS TX 76067-0760
	A NORTH AMERICAN PHILIPS CO		
	MINERAL WELLS AIRPORT		
20932	KYOCERA INTERNATIONAL INC	11620 SORRENTO VALLEY RD	SAN DIEGO CA 92121
		PO BOX 81543 PLANT NO 1	
24546	CORNING GLASS WORKS	550 HIGH ST	BRADFORD PA 16701-3737
27014	NATIONAL SEMICONDUCTOR CORP	2900 SEMICONDUCTOR DR	SANTA CLARA CA 95051-0606
31918	ITT SCHADOW INC	8081 WALLACE RD	EDEN PRAIRIE MN 55344-2224
34899	FAIR-RITE PRODUCTS CORP	1 COMMERCIAL ROW	WALLKILL NY 12589
50434	HEWLETT-PACKARD CO	370 W TRIMBLE RD	SAN JOSE CA 95131
	OPTOELECTRONICS DIV		
51406	MURATA ERIE NORTH AMERICA INC	2200 LAKE PARK DR	SMYRNA GA 30080
	HEADQUARTERS AND GEORGIA OPERATIONS		
52763	STETCO INC	3344 SCHIERHORN	FRANKLIN PARK IL 60131
52769	SPRAGUE-GOODMAN ELECTRONICS INC	134 FULTON AVE	GARDEN CITY PARK NY 11040-5352

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Mfr. Code	Manufacturer	Address	City, State, Zip Code
54473	MATSUSHITA ELECTRIC CORP OF AMERICA	ONE PANASONIC WAY PO BOX 1501	SECAUCUS NJ 07094-2917
55680	NICHICON /AMERICA/ CORP	927 E STATE PKY	SCHAUMBURG IL 60195-4526
56289	SPRAGUE ELECTRIC CO	92 HAYDEN AVE	LEXINGTON MA 02173-7929
	WORLD HEADQUARTERS		
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	114 OLD STATE RD PO BOX 14460	ST LOUIS MO 63178
75042	DIV OF COOPER INDUSTRIES INC	401 N BROAD ST	PHILADELPHIA PA 19108-1001
	IRC ELECTRONIC COMPONENTS		
	PHILADELPHIA DIV		
	TRW FIXED RESISTORS		
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97707-0001
91637	DALE ELECTRONICS INC	2064 12TH AVE PO BOX 609	COLUMBUS NE 68601-3632
D5243	ROEDERSTEIN E SPEZIALFABRIK FUER KONDENSATOREN GMBH	LUDMILLA STRASSE 23-25	8300 LANDSHUT GERMANY
K0491	SEAELECTRO LTD	WALTON ROAD FARLINGTON	PORTSMOUTH ENGLAND
K1439	STEALITE RÖDERSTEIN LTD	EDGBASTON	BIRMINGHAM 16 ENGLAND
	HAGLEY HOUSE		
K5545	AVEL LINDBERG LTD	ARCANY ROAD	ESSEX ENGLAND
	AVELEY INDUSTRIAL EST.	SOUTH OCKENDON	
K5856	RCA LTD	373-399 LONDON ROAD	SURREY ENGLAND
	BEECH HOUSE	CAMBERLEY	
K7068	SILICONIX LTD	MORRISTON	SWANSEA WALES
K7779	SIEMENS LTD	WINDMILL ROAD	MIDDLESEX TW16 7HS ENGLAND
	SIEMENS HOUSE	SUNBURY-ON-THAMES	
K8788	PIHER INTERNATIONAL LTD	HORTON ROAD	MIDDLESEX ENGLAND
		WEST DRAYTON	
K8996	MULLARD LIMITED	MULLARD HOUSE	LONDON WC1 7 HD ENGLAND
		TORRINGTON PLACE	
S4239	TEIKOKU TSUSHIN CORP	335 KARI YADO NAKAHARA-KU	KAWASKI JAPAN
TK00A	G ENGLISH ELECTRONICS LTD	34 BOWATER ROAD	LONDON SE18 5TF ENGLAND
TK0213	TOPTRON CORP		TOKYO JAPAN
TK0515	RIFA INC	403 INTERNATIONAL PKY PO BOX 853904	RICHARDSON TX 75085-3904
TKODY	A F BULGIN & CO LTD	BYE PASS ROAD	ESSEX ENGLAND
		BARKING	
TKODZ	ACROTRONICS	WOOD BURCOTE TRADING EST.	TOWCESTER ENGLAND
TKOEA	ARMON ELECTRONICS	109 WEMBLY HILL ROAD	MIDDX ENGLAND
	HERON HOUSE	WEMBLY	
TKOED	COMPONENTS BUREAU	135 DITTON WAY	CAMBRIDGE ENGLAND
	UNIT 4		
TKOEF	FERRANTI ELECTRONICS	FILEDS NEW ROAD	LANCS ENGLAND
		SHADDERTON - OLDHAM	
TKOEM	MOLEX ELECTRONICS	FARNHAM ROAD	HAMPSHIRE ENGLAND
	MOLEX HOUSE	BORDON	
TKOEN	MOTOROLA SEMICONDUCTORS	69 BUCKINGHAM STREET	BUCKS ENGLAND
	FAIRFAX HOUSE	AYLESBURY	
TKOFD	GB ELECTRONICS PRODUCTS LTD		WARE SG128EJ ENGLAND
TKOFJ	TEK GUERNSEY LTD		CHANNEL ISLANDS UNITED KINGDOM
TKOFV	EURAL LTD	ARLESEY	BEDS ENGLAND
TK1016	TOSHIBA AMERICA INC	2692 DOW AVE	TUSTIN CA 92680
	ELECTRONIC COMPONENTS DIV		
	BUSINESS SECTOR		
TK1573	WILHELM WESTERMAN	PO BOX 2345 AUGUSTA-ANLAGE 56	6800 MANNHEIM 1 WEST GERMANY
U1395	WELWYN ELECTRIC	BEDLINGTON	NORTHUMBERLAND NE22 7AA ENGLAND
U3771	STANLER COMPONENTS	HEY LANE	BRAINTREE ENGLAND
	BUSINESS CENTRE		

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

<u>Mfr. Code</u>	<u>Manufacturer</u>	<u>Address</u>	<u>City, State, Zip Code</u>
U4144	MURATA ELECTRONICS UK LTD	SOUTHWOOD FARNBOROUGH	HANTS ENGLAND

Component No.	Tektronix		Serial/Assembly No.		Name & Description	Mfr.	
	Part No.		Effective	Discont		Code	Mfr. Part No.
A1	671-0667-00				CIRCUIT BD ASSY:MAIN (A1)	80009	671-0667-00
A2	671-0668-00				CIRCUIT BD ASSY:ATTENUATOR/T.B.	80009	671-0668-00
A3	671-0669-00				CIRCUIT BD ASSY:FRONT PANEL	80009	671-0669-00
A4	670-9939-05				CIRCUIT BD ASSY:MAIN INLET	80009	670-9939-05
A5	670-9938-05				CIRCUIT BD ASSY:FOCUS CONTROL	80009	670-9938-05
A10	671-0670-00				CIRCUIT BD ASSY:STORAGE	80009	671-0670-00

Replaceable Electrical Parts - 2210 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Discont	Name & Description	Mfr. Code	Mfr. Part No.
A1	671-0667-00			CIRCUIT BD ASSY:MAIN (A1)	80009	671-0667-00
A1B1	119-3295-00			FAN,TUBEAXIAL:12V,1.2W,22CFM	80009	119-3295-00
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
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
A1C110	281-0810-00			CAP,FXD,CER DI:5.6PF,+/-0.5PF,100V	04222	MA101A5R6DAA
A1C111	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C112	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C114	281-0767-00			CAP,FXD,CER DI:330PF,20%,100V	04222	MA106C331MAA
A1C115	281-0767-00			CAP,FXD,CER DI:330PF,20%,100V	04222	MA106C331MAA
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	MA201C472KAA
A1C126	283-0114-02			CAP,FXD,CER DI:1500PF,5%,200V	59660	805-405-Y5D0152J
A1C130	283-0642-00			CAP,FXD,MICA DI:33PF,+/-0.5PF,300V	00853	D105E330G0
A1C133	281-0785-00			CAP,FXD,CER DI:68PF,10%,100V	04222	MA101A680KAA
A1C153	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
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	MA101A5R6DAA
A1C164	281-0767-00	200001	200368	CAP,FXD,CER DI:330PF,20%,100V	04222	MA106C331MAA
A1C164	281-0865-00	200369		CAP,FXD,CER DI:1000PF,5%,100V	04222	MA101A102JAA
A1C165	281-0767-00	200001	200368	CAP,FXD,CER DI:330PF,20%,100V	04222	MA106C331MAA
A1C165	281-0865-00	200369		CAP,FXD,CER DI:1000PF,5%,100V	04222	MA101A102JAA
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	MA201C472KAA
A1C176	283-0114-02			CAP,FXD,CER DI:1500PF,5%,200V	59660	805-405-Y5D0152J
A1C180	281-0158-00			CAP,VAR,CER DI:7-45PF,100WDC SUBMIN	59660	518-006 G 7-45
A1C215	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
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	281-0865-00	200001	200476	CAP,FXD,CER DI:1000PF,5%,100V	04222	MA101A102JAA
A1C225	281-0865-00	200477		CAP,FXD,CER DI:1000PF,5%,100V	04222	MA101A102JAA
A1C237	281-0140-00			CAP,VAR,CER DI:5-25PF,100V	59660	518-023A 5-25
A1C239	281-0776-00			CAP,FXD,CER DI:120PF,5%,100V	20932	401E0100AD121J
A1C240	283-0331-00			CAP,FXD,CER DI:43PF,2%,100V	18796	DD106B10NP0430J
A1C241	281-0816-00			CAP,FXD,CER DI:82 PF,5%,100V	04222	MA106A820JAA
A1C242	281-0865-00			CAP,FXD,CER DI:1000PF,5%,100V	04222	MA101A102JAA
A1C250	281-0768-00			CAP,FXD,CER DI:470PF,20%,100V	04222	MA101A471MAA
A1C251	281-0768-00			CAP,FXD,CER DI:470PF,20%,100V	04222	MA101A471MAA
A1C255	281-0865-00			CAP,FXD,CER DI:1000PF,5%,100V	04222	MA101A102JAA
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
A1C277	281-0773-00	200477		CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C292	290-1153-00			CAP,FXD,ELCTLT:47UF,+50-10%,10V	K8996	030-24479
A1C304	281-0768-00			CAP,FXD,CER DI:470PF,20%,100V	04222	MA101A471MAA
A1C305	281-0768-00			CAP,FXD,CER DI:470PF,20%,100V	04222	MA101A471MAA
A1C310	281-0762-00			CAP,FXD,CER DI:27PF,20%,100V	04222	MA101A270MAA
A1C335	281-0762-00			CAP,FXD,CER DI:27PF,20%,100V	04222	MA101A270MAA
A1C340	281-0762-00			CAP,FXD,CER DI:27PF,20%,100V	04222	MA101A270MAA
A1C349	285-1385-00			CAP,FXD,PLASTIC:43PF,2.5%,630V	K7779	B31063-A6430-H6
A1C351	281-0814-00			CAP,FXD,CER DI:100 PF,10%,100V	04222	MA101A101KAA
A1C353	281-0865-00			CAP,FXD,CER DI:1000PF,5%,100V	04222	MA101A102JAA
A1C369	281-0775-01			CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Discont	Name & Description	Mfr. Code	Mfr. Part No.
A1C372	281-0815-00			CAP,FXD,CER DI:0.027UF,20%,50V	04222	MA205C273MAA
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	MA101A270MAA
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	04222	MA101A101KAA
A1C398	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C400	281-0762-00			CAP,FXD,CER DI:27PF,20%,100V	04222	MA101A270MAA
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
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	290-1150-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C451	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
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	04222	MA101A101KAA
A1C462	290-0743-00			CAP,FXD,ELCTLT:100UF,+50%-20%,16WVDC	54473	ECE-B16V100L
A1C464	281-0775-01	200001	200258	CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C471	290-1150-00	200001	200258	CAP,FXD,ELCTLT:15UF,+50%-10%,16WVDC	K8996	030-25159
A1C471	131-0566-00	200259		BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1C472	290-1150-00	200001	200258	CAP,FXD,ELCTLT:15UF,+50%-10%,16WVDC	K8996	030-25159
A1C472	290-1210-00	200259		CAP,FXD,ELCTLT:10UF,10V	80009	290-1210-00
A1C473	281-0865-00			CAP,FXD,CER DI:1000PF,5%,100V	04222	MA101A102JAA
A1C479	290-1153-00	200001	200258	CAP,FXD,ELCTLT:47UF,+50%-10%,10V	K8996	030-24479
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	MA101A5R6DAA
A1C495	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C496	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
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	MA101A5R6DAA
A1C503	281-0772-00			CAP,FXD,CER DI:4700PF,10%,100V	04222	MA201C472KAA
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	MA106C331MAA
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
A1C536	281-0814-00			CAP,FXD,CER DI:100 PF,10%,100V	04222	MA101A101KAA
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	MA101A102JAA
A1C539	281-0865-00			CAP,FXD,CER DI:1000PF,5%,100V	04222	MA101A102JAA
A1C540	290-1153-00			CAP,FXD,ELCTLT:47UF,+50%-10%,10V	K8996	030-24479
A1C545	283-0119-02			CAP,FXD,CER DI:2200PF,5%,200V	59660	855-402-Y5E0222J
A1C547	281-0767-00			CAP,FXD,CER DI:330PF,20%,100V	04222	MA106C331MAA
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	MA101A102JAA
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	MA101A102JAA
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

Replaceable Electrical Parts - 2210 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscnt	Name & Description	Mfr. Code	Mfr. Part No.
A1C571	281-0785-00		CAP,FXD,CER DI:68PF,10%,100V	04222	MA101A680KAA
A1C572	281-0758-00		CAP,FXD,CER DI:15PF,20%,100V	04222	SA102A150MAA
A1C584	285-1341-00		CAP,FXD,PLASTIC:0.1UF,20%,100V	TK1573	MKS2 0.1/100/20
A1C587	281-0773-00		CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C601	281-0771-00		CAP,FXD,CER DI:2200PF,20%,200V	04222	SA106E222MAA
A1C776	281-0773-00		CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
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
A1C805	290-1150-00		CAP,FXD,ELCTLT:15UF,+50%-10%,16WVDC	K8996	030-25159
A1C817	281-0775-01		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1C823	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	MA101A680KAA
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	MA101A471MAA
A1C846	281-0772-00		CAP,FXD,CER DI:4700PF,10%,100V	04222	MA201C472KAA
A1C847	285-1341-00		CAP,FXD,PLASTIC:0.1UF,20%,100V	TK1573	MKS2 0.1/100/20
A1C849	285-1341-00		CAP,FXD,PLASTIC:0.1UF,20%,100V	TK1573	MKS2 0.1/100/20
A1C851	285-1341-00		CAP,FXD,PLASTIC:0.1UF,20%,100V	TK1573	MKS2 0.1/100/20
A1C853	281-0767-00		CAP,FXD,CER DI:330PF,20%,100V	04222	MA106C331MAA
A1C854	283-0279-00		CAP,FXD,CER DI:0.001UF,20%,3000V	51406	DHR12Y5S102M3KV
A1C855	285-1255-00		CAP,FXD,PLASTIC:0.01UF,20%,3KV	56289	430P582
A1C871	285-1341-00		CAP,FXD,PLASTIC:0.1UF,20%,100V	TK1573	MKS2 0.1/100/20
A1C875	285-1341-00		CAP,FXD,PLASTIC:0.1UF,20%,100V	TK1573	MKS2 0.1/100/20
A1C893	283-0279-00		CAP,FXD,CER DI:0.001UF,20%,3000V	51406	DHR12Y5S102M3KV
A1C901	281-0815-00		CAP,FXD,CER DI:0.027UF,20%,50V	04222	MA205C273MAA
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	MA101A102JAA
A1C909	281-0767-00		CAP,FXD,CER DI:330PF,20%,100V	04222	MA106C331MAA
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	04222	MA201C103KAA
A1C914	290-1160-00		CAP,FXD,ELCTLT:15UF,20%,63V	K8996	035-58159
A1C915	290-0768-00		CAP,FXD,ELCTLT:10UF,+50-20%,100WVDC	54473	ECE-A100V10L
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	MA106C331MAA
A1C940	281-0865-00		CAP,FXD,CER DI:1000PF,5%,100V	04222	MA101A102JAA
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	04222	MA101A101KAA
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	MA101A102JAA
A1C971	290-0831-00		CAP,FXD,ELCTLT:470UF,+50-20%,50V	54473	ECE-A1HV471S
A1C972	290-0831-00		CAP,FXD,ELCTLT:470UF,+50-20%,50V	54473	ECE-A1HV471S
A1C975	285-1255-00		CAP,FXD,PLASTIC:0.01UF,20%,3KV	56289	430P582

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
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	04222	MA101A101KAA
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	55680	UHC2C330TFA
A1C986	290-1159-00		CAP,FXD,ELCTLT:1000UF,20%,16V	TKOED	TWSS
A1C987	290-1159-00		CAP,FXD,ELCTLT:1000UF,20%,16V	TKOED	TWSS
A1C988	290-1159-00		CAP,FXD,ELCTLT:1000UF,20%,16V	TKOED	TWSS
A1C989	290-1159-00		CAP,FXD,ELCTLT:1000UF,20%,16V	TKOED	TWSS
A1C990	290-1159-00		CAP,FXD,ELCTLT:1000UF,20%,16V	TKOED	TWSS
A1C991	290-1159-00		CAP,FXD,ELCTLT:1000UF,20%,16V	TKOED	TWSS
A1C992	290-1159-00		CAP,FXD,ELCTLT:1000UF,20%,16V	TKOED	TWSS
A1C993	290-1159-00		CAP,FXD,ELCTLT:1000UF,20%,16V	TKOED	TWSS
A1C994	281-0775-01		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A1CR104	152-0322-00		SEMICON DVC,DI:SCHOTTKY,SI,15V,1.2PF,DO-35	50434	5082-2672
A1CR105	152-0322-00		SEMICON DVC,DI:SCHOTTKY,SI,15V,1.2PF,DO-35	50434	5082-2672
A1CR111	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR112	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR133	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR136	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR139	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR154	152-0322-00		SEMICON DVC,DI:SCHOTTKY,SI,15V,1.2PF,DO-35	50434	5082-2672
A1CR155	152-0322-00		SEMICON DVC,DI:SCHOTTKY,SI,15V,1.2PF,DO-35	50434	5082-2672
A1CR161	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR162	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR183	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR186	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR189	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR277	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR300	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR301	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR302	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR303	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR304	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR308	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR319	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR344	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR347	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR348	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR349	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR357	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR369	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR370	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR417	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR420	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR421	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR431	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR432	152-0322-00		SEMICON DVC,DI:SCHOTTKY,SI,15V,1.2PF,DO-35	50434	5082-2672
A1CR435	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR438	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR440	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR441	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR442	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR443	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR444	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR445	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR446	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR447	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)

Replaceable Electrical Parts - 2210 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1CR474	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR475	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR476	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR477	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR521	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR530	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR539	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR540	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR562	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR570	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR571	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR584	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR588	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR589	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR601	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR602	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR651	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR652	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR776	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR780	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR781	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR790	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR791	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR816	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR817	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR818	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR819	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR820	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR821	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR822	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR823	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR824	152-0322-00		SEMICON DVC,DI:SCHOTTKY,SI,15V,1.2PF,DO-35	50434	5082-2672
A1CR825	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR827	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR828	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR840	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR845	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR851	152-0242-00		SEMICON DVC,DI:SIG,SI,225V,0.2A,DO-7	07263	FDH5004
A1CR853	152-0242-00		SEMICON DVC,DI:SIG,SI,225V,0.2A,DO-7	07263	FDH5004
A1CR854	152-0242-00		SEMICON DVC,DI:SIG,SI,225V,0.2A,DO-7	07263	FDH5004
A1CR855	152-0242-00		SEMICON DVC,DI:SIG,SI,225V,0.2A,DO-7	07263	FDH5004
A1CR912	152-0808-00		SEMICON DVC,DI:RECT,SI,400V,1.5 A,50 NS	01281	DSR3400X
A1CR915	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR923	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR933	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR948	152-0141-02	200001 200694	SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR953	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR983	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A1CR984	152-0414-00		SEMICON DVC,DI:RECT,SI,200V,1.0A,TEK A59	80009	152-0414-00
A1CR985	152-0414-00		SEMICON DVC,DI:RECT,SI,200V,1.0A,TEK A59	80009	152-0414-00
A1CR986	152-0414-00		SEMICON DVC,DI:RECT,SI,200V,1.0A,TEK A59	80009	152-0414-00
A1CR987	152-0414-00		SEMICON DVC,DI:RECT,SI,200V,1.0A,TEK A59	80009	152-0414-00
A1CR988	152-0414-00		SEMICON DVC,DI:RECT,SI,200V,1.0A,TEK A59	80009	152-0414-00
A1CR989	152-0414-00		SEMICON DVC,DI:RECT,SI,200V,1.0A,TEK A59	80009	152-0414-00
A1CR990	152-0582-00		SEMICON DVC,DI:RECT,SI,20V,3A	80009	152-0582-00
A1CR991	152-0414-00		SEMICON DVC,DI:RECT,SI,200V,1.0A,TEK A59	80009	152-0414-00
A1CR992	152-0414-00		SEMICON DVC,DI:RECT,SI,200V,1.0A,TEK A59	80009	152-0414-00
A1CR993	152-0582-00		SEMICON DVC,DI:RECT,SI,20V,3A	80009	152-0582-00

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Discont	Name & Description	Mfr. Code	Mfr. Part No.
A1DL224	119-2611-00			DELAY LINE,ELEC:ASSEMBLY	80009	119-2611-00
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
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
A1J1	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TKOEM	52011-0610
A1J2	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TKOEM	52011-0610
A1J3	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TKOEM	52011-0610
A1J4	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TKOEM	52011-0610
A1J5	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TKOEM	52011-0610
A1J6	204-1034-00			CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TKOEM	52011-0610
A1J1011	204-1033-00			CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TKOEM	52011-0410
A1J1012	204-1033-00			CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TKOEM	52011-0410
A1L910	108-1424-00			COIL,RF:FXD,POWER INDUCTOR	TKOFD	ORDER BY DESCR
A1L970	108-1416-00	200001	200258	COIL,RF:POWER INDUCTOR,300UH-400UH,3A	80009	108-1416-00
A1L970	108-1375-00	200259		COIL,RF:FXD,82UH,1A	TK00A	RL-1218-820K-1A
A1L986	108-1416-00	200001	200258	COIL,RF:POWER INDUCTOR,300UH-400UH,3A	80009	108-1416-00
A1L986	108-1375-00	200259		COIL,RF:FXD,82UH,1A	TK00A	RL-1218-820K-1A
A1L988	108-1416-00	200001	200258	COIL,RF:POWER INDUCTOR,300UH-400UH,3A	80009	108-1416-00
A1L988	108-1375-00	200259		COIL,RF:FXD,82UH,1A	TK00A	RL-1218-820K-1A
A1L990	108-1446-00			INDUCTOR:FXD,62+/- 10%,5A	80009	108-1446-00
A1L991	120-1631-00			COIL,RF:FXD,210UH	TK00A	ORDER BY DESCR
A1P900	198-5589-01			WIRE SET,ELEC:	TK0FV	ORDER BY DESCR
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	80009	151-0190-00
A1Q105	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A1Q114	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A1Q115	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
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	80009	151-0190-00
A1Q155	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A1Q164	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A1Q165	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A1Q202	151-0711-00			TRANSISTOR:NPN,SI,TO-92B	80009	151-0711-00
A1Q203	151-0711-00			TRANSISTOR:NPN,SI,TO-92B	80009	151-0711-00
A1Q206	151-0221-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0221-00
A1Q207	151-0221-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0221-00
A1Q230	151-0221-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0221-00
A1Q231	151-0221-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0221-00
A1Q254	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A1Q255	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A1Q256	151-0869-00			TRANSISTOR:NPN,SI,TO-39	TK0EF	2N3866
A1Q257	151-0869-00			TRANSISTOR:NPN,SI,TO-39	TK0EF	2N3866
A1Q277	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A1Q283	151-0736-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0736-00
A1Q284	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A1Q285	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
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
A1Q368	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A1Q400	151-0712-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8223

Replaceable Electrical Parts - 2210 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Discnt	Name & Description	Mfr. Code	Mfr. Part No.
A1Q401	151-0712-00		TRANSISTOR:PNP,SI,TO-92	04713	SPS8223
A1Q415	151-0188-00		TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
A1Q420	151-0190-00		TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A1Q435	151-0188-00		TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
A1Q440	151-0188-00		TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
A1Q465	151-0188-00	200001 200258	TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
A1Q487	151-0188-00		TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
A1Q488	151-0188-00		TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
A1Q489	151-0188-00		TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
A1Q514	151-0188-00		TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
A1Q535	151-0188-00		TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
A1Q536	151-0188-00		TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
A1Q602	151-0188-00		TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
A1Q770	151-0188-00		TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
A1Q775	151-0347-00		TRANSISTOR:NPN,SI,TO-92	04713	SPS7951
A1Q776	151-0350-00		TRANSISTOR:PNP,SI,TO-92	04713	SPS6700
A1Q779	151-0350-00		TRANSISTOR:PNP,SI,TO-92	04713	SPS6700
A1Q780	151-0190-00		TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A1Q785	151-0347-00		TRANSISTOR:NPN,SI,TO-92	04713	SPS7951
A1Q789	151-0350-00		TRANSISTOR:PNP,SI,TO-92	04713	SPS6700
A1Q804	151-0188-00		TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
A1Q817	151-0190-00		TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A1Q835	151-0199-00		TRANSISTOR:PNP,SI,TO-92	80009	151-0199-00
A1Q840	151-0347-00		TRANSISTOR:NPN,SI,TO-92	04713	SPS7951
A1Q845	151-0350-00		TRANSISTOR:PNP,SI,TO-92	04713	SPS6700
A1Q885	151-0443-00		TRANSISTOR:PNP,SI,TO-92	04713	SPS7950
A1Q911	151-0347-00		TRANSISTOR:NPN,SI,TO-92	04713	SPS7951
A1Q912	151-0350-00		TRANSISTOR:PNP,SI,TO-92	04713	SPS6700
A1Q913	151-0462-00		TRANSISTOR:PNP,SI,TO-220	04713	SJE491
A1Q918	151-0188-00		TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
A1Q921	151-0276-01		TRANSISTOR:PNP,SI,TO-92	TK1016	S1423-TPE2
A1Q923	151-0476-02		TRANSISTOR:SELECTED	04713	SJE389
A1Q930	151-0424-00		TRANSISTOR:NPN,SI,TO-92	04713	SPS8246
A1Q940	151-0347-00		TRANSISTOR:NPN,SI,TO-92	04713	SPS7951
A1Q950	151-0462-00		TRANSISTOR:PNP,SI,TO-220	04713	SJE491
A1Q960	151-0424-00		TRANSISTOR:NPN,SI,TO-92	04713	SPS8246
A1Q970	151-0347-00		TRANSISTOR:NPN,SI,TO-92	04713	SPS7951
A1Q980	151-0462-00		TRANSISTOR:PNP,SI,TO-220	04713	SJE491
A1R100	315-0510-00		RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R101	315-0510-00		RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R102	321-0155-00		RES,FXD,FILM:402 OHM,1%,0.125W,TC=TO	07716	CEAD402R0F
A1R103	321-0155-00		RES,FXD,FILM:402 OHM,1%,0.125W,TC=TO	07716	CEAD402R0F
A1R104	321-0089-00		RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=TO	91637	CMF55116G82R50F
A1R105	321-0089-00		RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=TO	91637	CMF55116G82R50F
A1R106	321-0163-00		RES,FXD,FILM:487 OHM,1%,0.125W,TC=TO	07716	CEAD487R0F
A1R107	311-2355-00		RES,VAR,NONW:TRMR,100 OHM,20%,0.5W	K8788	TC10-LV10-100R/A
A1R108	321-0223-00		RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=TO	19701	5033ED2K05F
A1R109	321-0223-00		RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=TO	19701	5033ED2K05F
A1R110	321-0199-00		RES,FXD,FILM:1.15K OHM,1%,0.125W,TC=TO	07716	CEAD11500F
A1R111	321-0199-00		RES,FXD,FILM:1.15K OHM,1%,0.125W,TC=TO	07716	CEAD11500F
A1R112	311-2361-00		RES,VAR,NONW:TRMR,10K OHM,0.5W	K8788	TC10-LV10-10K/A
A1R114	321-0223-00		RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=TO	19701	5033ED2K05F
A1R115	321-0223-00		RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=TO	19701	5033ED2K05F
A1R117	315-0510-00		RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R118	315-0821-00		RES,FXD,FILM:820 OHM,5%,0.25W	19701	5043CX820R0J
A1R119	315-0821-00		RES,FXD,FILM:820 OHM,5%,0.25W	19701	5043CX820R0J
A1R120	321-0123-00		RES,FXD,FILM:187 OHM,1%,0.125W, TC=TO	07716	CEAD187R0F
A1R121	321-0123-00		RES,FXD,FILM:187 OHM,1%,0.125W, TC=TO	07716	CEAD187R0F

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Discont	Name & Description	Mfr. Code	Mfr. Part No.
A1R122	321-0089-00			RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=TO	91637	CMF55116682R50F
A1R124	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A1R125	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A1R126	315-0162-00			RES,FXD,FILM:1.6K OHM,5%,0.25W	19701	5043CX1K600J
A1R127	321-0068-00	200001	200694	RES,FXD,FILM:49.9 OHM,0.5%,0.125W,TC=TO	91637	CMF55116649R90F
A1R127	321-0063-00	200695		RES,FXD,FILM:44.2 OHM,0.5%,0.125W,TC=TO	91637	CMF55116644R20F
A1R128	315-0752-00			RES,FXD,FILM:7.5K OHM,5%,0.25W	57668	NTR25J-E07K5
A1R130	315-0510-00			RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R131	315-0510-00			RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R132	315-0511-00			RES,FXD,FILM:510 OHM,5%,0.25W	19701	5043CX510R0J
A1R133	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R135	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R136	315-0202-00			RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
A1R138	315-0202-00			RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
A1R139	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R140	311-2364-00			RES,VAR,NONWM:TRMR,4.7K OHM,0.5W	K8788	TC10-LV10-4K7/A
A1R142	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R143	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R144	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
A1R145	311-2354-00			RES,VAR,NONWM:TRMR,4.7K OHM,0.5W	K8788	TC10-LH2.5-4K7/A
A1R150	315-0510-00			RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R151	315-0510-00			RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R152	321-0155-00			RES,FXD,FILM:402 OHM,1%,0.125W,TC=TO	07716	CEAD402R0F
A1R153	321-0155-00			RES,FXD,FILM:402 OHM,1%,0.125W,TC=TO	07716	CEAD402R0F
A1R154	321-0089-00			RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=TO	91637	CMF55116682R50F
A1R155	321-0089-00			RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=TO	91637	CMF55116682R50F
A1R156	321-0163-00			RES,FXD,FILM:487 OHM,1%,0.125W,TC=TO	07716	CEAD487R0F
A1R158	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=TO	19701	5033ED2K05F
A1R159	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=TO	19701	5033ED2K05F
A1R160	321-0199-00			RES,FXD,FILM:1.15K OHM,1%,0.125W,TC=TO	07716	CEAD11500F
A1R161	321-0199-00			RES,FXD,FILM:1.15K OHM,1%,0.125W,TC=TO	07716	CEAD11500F
A1R164	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=TO	19701	5033ED2K05F
A1R165	321-0223-00			RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=TO	19701	5033ED2K05F
A1R167	315-0510-00			RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R168	315-0821-00			RES,FXD,FILM:820 OHM,5%,0.25W	19701	5043CX820R0J
A1R169	315-0821-00			RES,FXD,FILM:820 OHM,5%,0.25W	19701	5043CX820R0J
A1R170	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=TO	07716	CEAD187R0F
A1R171	321-0123-00			RES,FXD,FILM:187 OHM,1%,0.125W, TC=TO	07716	CEAD187R0F
A1R172	321-0089-00			RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=TO	91637	CMF55116682R50F
A1R174	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A1R175	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A1R176	315-0162-00			RES,FXD,FILM:1.6K OHM,5%,0.25W	19701	5043CX1K600J
A1R177	321-0068-00	200001	200694	RES,FXD,FILM:49.9 OHM,0.5%,0.125W,TC=TO	91637	CMF55116649R90F
A1R177	321-0063-00	200695		RES,FXD,FILM:44.2 OHM,0.5%,0.125W,TC=TO	91637	CMF55116644R20F
A1R178	315-0752-00			RES,FXD,FILM:7.5K OHM,5%,0.25W	57668	NTR25J-E07K5
A1R180	315-0510-00			RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R181	315-0510-00			RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R182	315-0511-00			RES,FXD,FILM:510 OHM,5%,0.25W	19701	5043CX510R0J
A1R183	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R185	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R186	315-0202-00			RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
A1R188	315-0202-00			RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
A1R189	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A1R192	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R193	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R194	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
A1R195	311-2354-00			RES,VAR,NONWM:TRMR,4.7K OHM,0.5W	K8788	TC10-LH2.5-4K7/A
A1R202	321-0178-00			RES,FXD,FILM:698 OHM,1%,0.125W,TC=TO	07716	CEAD698R0F

Replaceable Electrical Parts - 2210 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Discnt	Name & Description	Mfr. Code	Mfr. Part No.
A1R203	321-0178-00		RES,FXD,FILM:698 OHM,1%,0.125W,TC=TO	07716	CEAD698ROF
A1R204	321-0089-00		RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=TO	91637	CMF55116G82R50F
A1R206	315-0271-00		RES,FXD,FILM:270 OHM,5%,0.25W	57668	NTR25J-E270E
A1R207	315-0271-00		RES,FXD,FILM:270 OHM,5%,0.25W	57668	NTR25J-E270E
A1R212	321-0089-00		RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=TO	91637	CMF55116G82R50F
A1R213	321-0089-00		RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=TO	91637	CMF55116G82R50F
A1R215	315-0241-00		RES,FXD,FILM:240 OHM,5%,0.25W	19701	5043CX240ROJ
A1R216	321-0163-00		RES,FXD,FILM:487 OHM,1%,0.125W,TC=TO	07716	CEAD487ROF
A1R217	321-0163-00		RES,FXD,FILM:487 OHM,1%,0.125W,TC=TO	07716	CEAD487ROF
A1R218	321-0109-00		RES,FXD,FILM:133 OHM,1%,0.125W,TC=TO	07716	CEAD133ROF
A1R219	321-0109-00		RES,FXD,FILM:133 OHM,1%,0.125W,TC=TO	07716	CEAD133ROF
A1R222	321-0318-00		RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=TO	19701	5033ED20K00F
A1R223	321-0318-00		RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=TO	19701	5033ED20K00F
A1R225	321-0255-00		RES,FXD,FILM:4.42K OHM,1%,0.125W,TC=TO	19701	5033ED4K420F
A1R226	321-0337-00		RES,FXD,FILM:31.6K OHM,1%,0.125W,TC=TO	07716	CEAD31601F
A1R230	321-0093-00		RES,FXD,FILM:90.9 OHM,1%,0.125W,TC=TO	19701	5043ED90R90F
A1R231	321-0093-00		RES,FXD,FILM:90.9 OHM,1%,0.125W,TC=TO	19701	5043ED90R90F
A1R233	321-0089-00		RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=TO	91637	CMF55116G82R50F
A1R234	321-0068-00		RES,FXD,FILM:49.9 OHM,0.5%,0.125W,TC=TO	91637	CMF55116G49R90F
A1R235	321-0068-00		RES,FXD,FILM:49.9 OHM,0.5%,0.125W,TC=TO	91637	CMF55116G49R90F
A1R236	321-0172-00		RES,FXD,FILM:604 OHM,1%,0.125W,TC=TO	19701	5033ED604ROF
A1R239	315-0512-00		RES,FXD,FILM:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A1R240	311-2365-00		RES,VAR,NONW:TRMR,470 OHM,0.75W	K8788	TC10-LV10-470K/A
A1R241	311-2364-00		RES,VAR,NONW:TRMR,4.7K OHM,0.5W	K8788	TC10-LV10-4K7/A
A1R242	315-0273-00		RES,FXD,FILM:27K OHM,5%,0.25W	57668	NTR25J-E27K0
A1R244	321-0172-00		RES,FXD,FILM:604 OHM,1%,0.125W,TC=TO	19701	5033ED604ROF
A1R245	321-0172-00		RES,FXD,FILM:604 OHM,1%,0.125W,TC=TO	19701	5033ED604ROF
A1R250	315-0221-00		RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A1R251	315-0221-00		RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A1R254	321-0109-00		RES,FXD,FILM:133 OHM,1%,0.125W,TC=TO	07716	CEAD133ROF
A1R255	321-0109-00		RES,FXD,FILM:133 OHM,1%,0.125W,TC=TO	07716	CEAD133ROF
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	315-0181-00		RES,FXD,FILM:180 OHM,5%,0.25W	57668	NTR25J-E180E
A1R259	315-0181-00		RES,FXD,FILM:180 OHM,5%,0.25W	57668	NTR25J-E180E
A1R261	307-1340-00		RES,FXD,FILM:22 OHM,5%,1W	K1439	5K/5
A1R262	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R266	308-0936-00		RES,FXD,WW:3300HM,5%,7W	U1395	ORDER BY DESCR
A1R267	308-0936-00		RES,FXD,WW:3300HM,5%,7W	U1395	ORDER BY DESCR
A1R272	301-0101-00		RES,FXD,FILM:100 OHM,5%,0.5W	01121	EB1015
A1R273	301-0101-00		RES,FXD,FILM:100 OHM,5%,0.5W	01121	EB1015
A1R277	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R279	315-0223-00		RES,FXD,FILM:22K OHM,5%,0.25W	19701	5043CX22K00J92U
A1R281	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R282	315-0182-00		RES,FXD,FILM:1.8K OHM,5%,0.25W	57668	NTR25J-E1K8
A1R283	315-0471-00		RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
A1R284	321-0172-00		RES,FXD,FILM:604 OHM,1%,0.125W,TC=TO	19701	5033ED604ROF
A1R285	315-0511-00		RES,FXD,FILM:510 OHM,5%,0.25W	19701	5043CX510ROJ
A1R286	321-0068-00		RES,FXD,FILM:49.9 OHM,0.5%,0.125W,TC=TO	91637	CMF55116G49R90F
A1R287	321-0068-00		RES,FXD,FILM:49.9 OHM,0.5%,0.125W,TC=TO	91637	CMF55116G49R90F
A1R288	321-0158-00		RES,FXD,FILM:432 OHM,1%,0.125W,TC=TO	07716	CEAD432ROF
A1R289	321-0158-00		RES,FXD,FILM:432 OHM,1%,0.125W,TC=TO	07716	CEAD432ROF
A1R290	321-0199-00		RES,FXD,FILM:1.15K OHM,1%,0.125W,TC=TO	07716	CEAD11500F
A1R291	321-0199-00		RES,FXD,FILM:1.15K OHM,1%,0.125W,TC=TO	07716	CEAD11500F
A1R292	321-0182-00		RES,FXD,FILM:768 OHM,1%,0.125W,TC=TO	07716	CEAD768ROF
A1R293	315-0120-00		RES,FXD,FILM:12 OHM,5%,0.25W	57668	NTR25J-R12
A1R294	321-0172-00		RES,FXD,FILM:604 OHM,1%,0.125W,TC=TO	19701	5033ED604ROF
A1R295	321-0172-00		RES,FXD,FILM:604 OHM,1%,0.125W,TC=TO	19701	5033ED604ROF

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1R300	315-0273-00		RES,FXD,FILM:27K OHM,5%,0.25W	57668	NTR25J-E27K0
A1R301	315-0273-00		RES,FXD,FILM:27K OHM,5%,0.25W	57668	NTR25J-E27K0
A1R303	321-0318-00		RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=TO	19701	5033ED20K00F
A1R304	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R308	321-0318-00		RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=TO	19701	5033ED20K00F
A1R309	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R310	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R311	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R312	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R313	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R314	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R316	315-0471-00		RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
A1R317	315-0241-00		RES,FXD,FILM:240 OHM,5%,0.25W	19701	5043CX240R0J
A1R318	315-0241-00		RES,FXD,FILM:240 OHM,5%,0.25W	19701	5043CX240R0J
A1R319	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R320	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R321	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R322	321-0089-00		RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=TO	91637	CMF55116682R50F
A1R323	321-0089-00		RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=TO	91637	CMF55116682R50F
A1R325	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R326	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R327	321-0155-00		RES,FXD,FILM:402 OHM,1%,0.125W,TC=TO	07716	CEAD402R0F
A1R328	321-0155-00		RES,FXD,FILM:402 OHM,1%,0.125W,TC=TO	07716	CEAD402R0F
A1R329	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R330	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R331	315-0241-00		RES,FXD,FILM:240 OHM,5%,0.25W	19701	5043CX240R0J
A1R332	315-0241-00		RES,FXD,FILM:240 OHM,5%,0.25W	19701	5043CX240R0J
A1R333	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R334	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R335	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R336	321-0089-00		RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=TO	91637	CMF55116682R50F
A1R337	321-0089-00		RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=TO	91637	CMF55116682R50F
A1R338	311-2365-00		RES,VAR,NONWW:TRMR,470 OHM,0.75W	K8788	TC10-LV10-470K/A
A1R339	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R340	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R343	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R344	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R345	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R346	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R347	315-0182-00		RES,FXD,FILM:1.8K OHM,5%,0.25W	57668	NTR25J-E1K8
A1R348	315-0512-00		RES,FXD,FILM:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A1R349	315-0202-00		RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
A1R351	315-0202-00		RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
A1R352	315-0202-00		RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
A1R353	315-0182-00		RES,FXD,FILM:1.8K OHM,5%,0.25W	57668	NTR25J-E1K8
A1R354	321-0172-00		RES,FXD,FILM:604 OHM,1%,0.125W,TC=TO	19701	5033ED604R0F
A1R355	315-0680-00		RES,FXD,FILM:68 OHM,5%,0.25W	57668	NTR25J-E68E0
A1R356	315-0680-00		RES,FXD,FILM:68 OHM,5%,0.25W	57668	NTR25J-E68E0
A1R357	321-0093-00		RES,FXD,FILM:90.9 OHM,1%,0.125W,TC=TO	19701	5043ED90R90F
A1R358	315-0510-00		RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R359	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R360	311-2420-00		RES,VAR,NONWW:TRMR,10K	K8788	ORDER BY DESCR
A1R361	321-0172-00		RES,FXD,FILM:604 OHM,1%,0.125W,TC=TO	19701	5033ED604R0F
A1R362	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R363	321-0123-00		RES,FXD,FILM:187 OHM,1%,0.125W, TC=TO	07716	CEAD187R0F
A1R364	321-0123-00		RES,FXD,FILM:187 OHM,1%,0.125W, TC=TO	07716	CEAD187R0F
A1R366	321-0068-00		RES,FXD,FILM:49.9 OHM,0.5%,0.125W,TC=TO	91637	CMF55116649R90F
A1R367	321-0068-00		RES,FXD,FILM:49.9 OHM,0.5%,0.125W,TC=TO	91637	CMF55116649R90F

Replaceable Electrical Parts - 2210 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1R368	315-0331-00		RES,FXD,FILM:330 OHM,5%,0.25W	57668	NTR25J-E330E
A1R369	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R374	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R375	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R380	315-0202-00		RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
A1R381	315-0562-00		RES,FXD,FILM:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
A1R384	315-0510-00		RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R385	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R386	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R387	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R388	315-0221-00		RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A1R389	315-0202-00		RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
A1R390	315-0752-00		RES,FXD,FILM:7.5K OHM,5%,0.25W	57668	NTR25J-E07K5
A1R391	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R392	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R393	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R394	315-0202-00		RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
A1R395	311-2363-00		RES,VAR,NONWR:TRMR,1K OHM,0.5W	K8788	TC10-LV10-1K/A
A1R396	315-0182-00		RES,FXD,FILM:1.8K OHM,5%,0.25W	57668	NTR25J-E1K8
A1R397	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R398	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R400	321-0089-00		RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=TO	91637	CMF55116GB2R50F
A1R401	321-0089-00		RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=TO	91637	CMF55116GB2R50F
A1R402	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R403	315-0221-00		RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A1R404	315-0120-00		RES,FXD,FILM:12 OHM,5%,0.25W	57668	NTR25J-R12
A1R405	315-0120-00		RES,FXD,FILM:12 OHM,5%,0.25W	57668	NTR25J-R12
A1R406	315-0202-00		RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
A1R407	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R408	315-0202-00		RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
A1R409	315-0302-00		RES,FXD,FILM:3K OHM,5%,0.25W	57668	NTR25J-E03K0
A1R410	315-0392-00		RES,FXD,FILM:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A1R412	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R413	315-0562-00		RES,FXD,FILM:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
A1R414	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R415	315-0120-00		RES,FXD,FILM:12 OHM,5%,0.25W	57668	NTR25J-R12
A1R416	315-0204-00		RES,FXD,FILM:200K OHM,5%,0.25W	19701	5043CX200K0J
A1R417	315-0562-00		RES,FXD,FILM:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
A1R418	315-0204-00		RES,FXD,FILM:200K OHM,5%,0.25W	19701	5043CX200K0J
A1R419	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R420	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R421	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R422	315-0221-00		RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A1R423	315-0221-00		RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A1R424	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R425	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R427	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R428	315-0243-00		RES,FXD,FILM:24K OHM,5%,0.25W	57668	NTR25J-E24K0
A1R429	315-0510-00		RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R430	315-0204-00		RES,FXD,FILM:200K OHM,5%,0.25W	19701	5043CX200K0J
A1R432	315-0204-00		RES,FXD,FILM:200K OHM,5%,0.25W	19701	5043CX200K0J
A1R433	315-0223-00		RES,FXD,FILM:22K OHM,5%,0.25W	19701	5043CX22K00J92U
A1R434	315-0391-00		RES,FXD,FILM:390 OHM,5%,0.25W	57668	NTR25J-E390E
A1R435	321-0155-00		RES,FXD,FILM:402 OHM,1%,0.125W,TC=TO	07716	CEAD402R0F
A1R436	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R437	315-0752-00		RES,FXD,FILM:7.5K OHM,5%,0.25W	57668	NTR25J-E07K5
A1R438	315-0204-00		RES,FXD,FILM:200K OHM,5%,0.25W	19701	5043CX200K0J
A1R439	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Discont	Name & Description	Mfr. Code	Mfr. Part No.
A1R440	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A1R441	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R442	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R443	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R444	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R445	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A1R446	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A1R447	315-0510-00			RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R448	315-0510-00			RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R449	315-0162-00			RES,FXD,FILM:1.6K OHM,5%,0.25W	19701	5043CX1K600J
A1R450	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R451	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R452	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R453	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R454	321-0361-00			RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=TO	07716	CEAD56201F
A1R455	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R456	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R457	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R458	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R459	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A1R460	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R461	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R462	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R463	315-0104-00	200001	200258	RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R464	315-0104-00	200001	200258	RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R465	315-0103-00	200001	200258	RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R466	315-0103-00	200001	200258	RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R467	315-0103-00	200001	200258	RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R468	315-0204-00			RES,FXD,FILM:200K OHM,5%,0.25W	19701	5043CX200K0J
A1R469	315-0103-00	200001	200258	RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R470	315-0204-00			RES,FXD,FILM:200K OHM,5%,0.25W	19701	5043CX200K0J
A1R471	315-0204-00	200001	200258	RES,FXD,FILM:200K OHM,5%,0.25W	19701	5043CX200K0J
A1R472	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R473	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R474	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R475	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A1R476	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R477	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25W	19701	5043CX1M000J
A1R478	311-2358-00			RES,VAR,NONW:TRMR,100K OHM,0.5W	K8788	TC10-LV10-100K/A
A1R479	315-0203-00	200001	200258	RES,FXD,FILM:20K OHM,5%,0.25W	57668	NTR25J-E 20K
A1R480	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R481	311-2361-00			RES,VAR,NONW:TRMR,10K OHM,0.5W	K8788	TC10-LV10-10K/A
A1R482	315-0271-00			RES,FXD,FILM:270 OHM,5%,0.25W	57668	NTR25J-E270E
A1R483	321-0158-00			RES,FXD,FILM:432 OHM,1%,0.125W,TC=TO	07716	CEAD432R0F
A1R485	321-0089-00			RES,FXD,FILM:82.5 OHM,1%,0.125W,TC=TO	91637	CMF55116G82R50F
A1R486	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A1R487	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R488	315-0391-00			RES,FXD,FILM:390 OHM,5%,0.25W	57668	NTR25J-E390E
A1R489	311-2352-00			RES,VAR,NONW:TRMR,220 OHM,0.5W	K8788	TC10LV2.5220R
A1R490	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A1R491	315-0391-00			RES,FXD,FILM:390 OHM,5%,0.25W	57668	NTR25J-E390E
A1R492	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R493	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R495	315-0752-00			RES,FXD,FILM:7.5K OHM,5%,0.25W	57668	NTR25J-E07K5
A1R496	315-0752-00			RES,FXD,FILM:7.5K OHM,5%,0.25W	57668	NTR25J-E07K5
A1R497	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
A1R498	321-0158-00			RES,FXD,FILM:432 OHM,1%,0.125W,TC=TO	07716	CEAD432R0F
A1R501	321-0322-00			RES,FXD,FILM:22.1K OHM,0.1%,0.125W,TC=TO	19701	5033ED22K10F

Replaceable Electrical Parts - 2210 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1R502	321-0318-00		RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=TO	19701	5033ED20K00F
A1R503	321-0318-00		RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=TO	19701	5033ED20K00F
A1R504	315-0202-00		RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
A1R505	315-0334-00		RES,FXD,FILM:330K OHM,5%,0.25W	57668	NTR25J-E 330K
A1R506	315-0202-00		RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
A1R508	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R512	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R514	321-0172-00		RES,FXD,FILM:604 OHM,1%,0.125W,TC=TO	19701	5033ED604R0F
A1R515	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R516	315-0472-00		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A1R520	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R521	315-0182-00		RES,FXD,FILM:1.8K OHM,5%,0.25W	57668	NTR25J-E1K8
A1R522	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R523	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R524	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R525	315-0222-00		RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A1R526	315-0222-00		RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A1R530	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R531	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R532	315-0222-00		RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A1R533	315-0511-00		RES,FXD,FILM:510 OHM,5%,0.25W	19701	5043CX510R0J
A1R534	315-0511-00		RES,FXD,FILM:510 OHM,5%,0.25W	19701	5043CX510R0J
A1R535	315-0181-00		RES,FXD,FILM:180 OHM,5%,0.25W	57668	NTR25J-E180E
A1R536	315-0181-00		RES,FXD,FILM:180 OHM,5%,0.25W	57668	NTR25J-E180E
A1R537	315-0221-00		RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A1R538	315-0512-00		RES,FXD,FILM:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A1R539	315-0512-00		RES,FXD,FILM:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A1R540	315-0511-00		RES,FXD,FILM:510 OHM,5%,0.25W	19701	5043CX510R0J
A1R541	315-0511-00		RES,FXD,FILM:510 OHM,5%,0.25W	19701	5043CX510R0J
A1R542	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R543	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R544	321-0158-00		RES,FXD,FILM:432 OHM,1%,0.125W,TC=TO	07716	CEAD432R0F
A1R545	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R547	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R548	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R549	321-0172-00		RES,FXD,FILM:604 OHM,1%,0.125W,TC=TO	19701	5033ED604R0F
A1R550	315-0512-00		RES,FXD,FILM:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A1R551	315-0182-00		RES,FXD,FILM:1.8K OHM,5%,0.25W	57668	NTR25J-E1K8
A1R552	315-0222-00		RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A1R553	315-0511-00		RES,FXD,FILM:510 OHM,5%,0.25W	19701	5043CX510R0J
A1R554	315-0222-00		RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A1R555	315-0391-00		RES,FXD,FILM:390 OHM,5%,0.25W	57668	NTR25J-E390E
A1R556	315-0222-00		RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A1R557	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R560	315-0271-00		RES,FXD,FILM:270 OHM,5%,0.25W	57668	NTR25J-E270E
A1R561	315-0512-00		RES,FXD,FILM:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A1R562	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R563	315-0302-00		RES,FXD,FILM:3K OHM,5%,0.25W	57668	NTR25J-E03K0
A1R564	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R565	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R570	315-0392-00		RES,FXD,FILM:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A1R571	315-0392-00		RES,FXD,FILM:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A1R572	315-0222-00		RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A1R573	315-0222-00		RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A1R574	315-0222-00		RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A1R575	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R576	315-0222-00		RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A1R577	315-0470-00		RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1R579	315-0221-00		RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
A1R580	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R581	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R582	321-0361-00		RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=TO	07716	CEAD56201F
A1R583	315-0204-00		RES,FXD,FILM:200K OHM,5%,0.25W	19701	5043CX200K0J
A1R584	315-0334-00		RES,FXD,FILM:330K OHM,5%,0.25W	57668	NTR25J-E 330K
A1R585	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R586	315-0334-00		RES,FXD,FILM:330K OHM,5%,0.25W	57668	NTR25J-E 330K
A1R587	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R588	315-0182-00		RES,FXD,FILM:1.8K OHM,5%,0.25W	57668	NTR25J-E1K8
A1R589	321-0318-00		RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=TO	19701	5033ED20K00F
A1R590	321-0205-00		RES,FXD,FILM:1.33K OHM,1%,0.125W,TC=TO	19701	5033ED1K330F
A1R600	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R601	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R602	315-0302-00		RES,FXD,FILM:3K OHM,5%,0.25W	57668	NTR25J-E03K0
A1R603	315-0112-00		RES,FXD,FILM:1.1K OHM,5%,0.25W	19701	5043CX1K100J
A1R604	315-0270-00		RES,FXD,FILM:27 OHM,5%,0.25W	19701	5043CX27R00J
A1R605	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R651	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R653	315-0112-00		RES,FXD,FILM:1.1K OHM,5%,0.25W	19701	5043CX1K100J
A1R654	315-0270-00		RES,FXD,FILM:27 OHM,5%,0.25W	19701	5043CX27R00J
A1R764	315-0471-00		RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
A1R776	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R778	321-0361-00		RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=TO	07716	CEAD56201F
A1R779	321-0263-00		RES,FXD,FILM:5.36K OHM,1%,0.125W,TC=TO	07716	CEAD53600F
A1R780	315-0510-00		RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R781	321-0109-00		RES,FXD,FILM:133 OHM,1%,0.125W,TC=TO	07716	CEAD133R0F
A1R784	323-0310-00		RES,FXD,FILM:16.5K OHM,1%,0.5W,TC=TO	75042	CECT0-1652F
A1R785	315-0243-00		RES,FXD,FILM:24K OHM,5%,0.25W	57668	NTR25J-E24K0
A1R786	321-0182-00		RES,FXD,FILM:768 OHM,1%,0.125W,TC=TO	07716	CEAD768R0F
A1R787	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R788	321-0205-00		RES,FXD,FILM:1.33K OHM,1%,0.125W,TC=TO	19701	5033ED1K330F
A1R789	315-0510-00		RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R790	315-0510-00		RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R791	321-0158-00		RES,FXD,FILM:432 OHM,1%,0.125W,TC=TO	07716	CEAD432R0F
A1R792	321-0223-00		RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=TO	19701	5033ED2K05F
A1R794	323-0310-00		RES,FXD,FILM:16.5K OHM,1%,0.5W,TC=TO	75042	CECT0-1652F
A1R795	315-0243-00		RES,FXD,FILM:24K OHM,5%,0.25W	57668	NTR25J-E24K0
A1R796	321-0201-00		RES,FXD,FILM:1.21K OHM,1%,0.125W,TC=TO	19701	5043ED1K210F
A1R797	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R798	321-0205-00		RES,FXD,FILM:1.33K OHM,1%,0.125W,TC=TO	19701	5033ED1K330F
A1R799	315-0510-00		RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R804	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R805	315-0562-00		RES,FXD,FILM:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
A1R806	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R818	315-0302-00		RES,FXD,FILM:3K OHM,5%,0.25W	57668	NTR25J-E03K0
A1R819	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R820	315-0362-00		RES,FXD,FILM:3.6K OHM,5%,0.25W	19701	5043CX3K600J
A1R821	315-0302-00		RES,FXD,FILM:3K OHM,5%,0.25W	57668	NTR25J-E03K0
A1R822	321-0361-00		RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=TO	07716	CEAD56201F
A1R823	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R824	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R825	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R828	321-0318-00		RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=TO	19701	5033ED20K00F
A1R832	321-0223-00		RES,FXD,FILM:2.05K OHM,1%,0.125W,TC=TO	19701	5033ED2K05F
A1R834	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R835	321-0225-00		RES,FXD,FILM:2.15K OHM,1%,0.125W,TC=TO	19701	5033ED2K15F
A1R836	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0

Replaceable Electrical Parts - 2210 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Discnt	Name & Description	Mfr. Code	Mfr. Part No.
A1R840	315-0511-00		RES,FXD,FILM:510 OHM,5%,0.25W	19701	5043CX510R0J
A1R841	321-0322-00		RES,FXD,FILM:22.1K OHM,0.1%,0.125W,TC=TO	19701	5033ED22K10F
A1R842	315-0241-00		RES,FXD,FILM:240 OHM,5%,0.25W	19701	5043CX240R0J
A1R844	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R845	315-0472-00		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A1R846	315-0181-00		RES,FXD,FILM:180 OHM,5%,0.25W	57668	NTR25J-E180E
A1R849	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R850	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R851	311-2367-00		RES,VAR,NONW:TRMR,22K OHM,0.5W	K8788	TC10-LV10-22K/A
A1R852	321-0318-00		RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=TO	19701	5033ED20K00F
A1R853	315-0204-00		RES,FXD,FILM:200K OHM,5%,0.25W	19701	5043CX200K0J
A1R854	315-0472-00		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A1R858	315-0511-00		RES,FXD,FILM:510 OHM,5%,0.25W	19701	5043CX510R0J
A1R860	315-0625-00		RES,FXD,FILM:6.2M OHM,5%,0.25W	01121	C86255
A1R870	311-2358-00		RES,VAR,NONW:TRMR,100K OHM,0.5W	K8788	TC10-LV10-100K/A
A1R872	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R873	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R874	311-2358-00		RES,VAR,NONW:TRMR,100K OHM,0.5W	K8788	TC10-LV10-100K/A
A1R875	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R877	307-0115-00		RES,FXD,CMPSN:7.5 OHM,5%,0.25W	80009	307-0115-00
A1R885	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R886	315-0204-00		RES,FXD,FILM:200K OHM,5%,0.25W	19701	5043CX200K0J
A1R888	301-0105-00		RES,FXD,FILM:1M OHM,5%,0.50W	19701	5053CX1M000J
A1R889	301-0105-00		RES,FXD,FILM:1M OHM,5%,0.50W	19701	5053CX1M000J
A1R890	301-0105-00		RES,FXD,FILM:1M OHM,5%,0.50W	19701	5053CX1M000J
A1R891	301-0105-00		RES,FXD,FILM:1M OHM,5%,0.50W	19701	5053CX1M000J
A1R892	301-0105-00		RES,FXD,FILM:1M OHM,5%,0.50W	19701	5053CX1M000J
A1R894	301-0105-00		RES,FXD,FILM:1M OHM,5%,0.50W	19701	5053CX1M000J
A1R898	315-0391-00		RES,FXD,FILM:390 OHM,5%,0.25W	57668	NTR25J-E390E
A1R899	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R900	315-0105-00		RES,FXD,FILM:1M OHM,5%,0.25W	19701	5043CX1M000J
A1R901	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R907	308-0843-00		RES,FXD,WW:0.2 OHM,5%,1/0W	91637	RS1A-90-R2J
A1R908	321-0337-00		RES,FXD,FILM:31.6K OHM,1%,0.125W,TC=TO	07716	CEAD31601F
A1R909	315-0222-00		RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A1R910	321-0205-00		RES,FXD,FILM:1.33K OHM,1%,0.125W,TC=TO	19701	5033ED1K330F
A1R911	315-0223-00		RES,FXD,FILM:22K OHM,5%,0.25W	19701	5043CX22K00J92U
A1R912	315-0752-00		RES,FXD,FILM:7.5K OHM,5%,0.25W	57668	NTR25J-E07K5
A1R913	321-0318-00		RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=TO	19701	5033ED20K00F
A1R914	315-0105-00		RES,FXD,FILM:1M OHM,5%,0.25W	19701	5043CX1M000J
A1R915	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R916	315-0222-00		RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A1R917	321-0361-00		RES,FXD,FILM:56.2K OHM,1%,0.125W,TC=TO	07716	CEAD56201F
A1R918	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R919	315-0182-00		RES,FXD,FILM:1.8K OHM,5%,0.25W	57668	NTR25J-E1K8
A1R920	315-0510-00		RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A1R921	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R922	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R923	315-0471-00		RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
A1R924	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R925	315-0204-00		RES,FXD,FILM:200K OHM,5%,0.25W	19701	5043CX200K0J
A1R926	315-0273-00		RES,FXD,FILM:27K OHM,5%,0.25W	57668	NTR25J-E27K0
A1R927	321-0322-00		RES,FXD,FILM:22.1K OHM,0.1%,0.125W,TC=TO	19701	5033ED22K10F
A1R928	321-0337-00		RES,FXD,FILM:31.6K OHM,1%,0.125W,TC=TO	07716	CEAD31601F
A1R929	321-0318-00		RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=TO	19701	5033ED20K00F
A1R930	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R931	315-0471-00		RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
A1R932	315-0243-00		RES,FXD,FILM:24K OHM,5%,0.25W	57668	NTR25J-E24K0

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1R933	311-2364-00		RES,VAR,NONWM:TRMR,4.7K OHM,0.5W	K8788	TC10-LV10-4K7/A
A1R934	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R935	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R936	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R937	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R938	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R939	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R940	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R941	321-0253-00		RES,FXD,FILM:4.22K OHM,1%,0.125W,TC=TO	19701	5033ED 4K 220F
A1R942	321-0337-00		RES,FXD,FILM:31.6K OHM,1%,0.125W,TC=TO	07716	CEAD31601F
A1R943	315-0243-00		RES,FXD,FILM:24K OHM,5%,0.25W	57668	NTR25J-E24K0
A1R944	315-0392-00		RES,FXD,FILM:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A1R945	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R946	315-0512-00		RES,FXD,FILM:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A1R947	131-0566-00		BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1R952	315-0471-00		RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
A1R953	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R965	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R966	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A1R967	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A1R968	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R969	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A1R975	315-0562-00		RES,FXD,FILM:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
A1R976	315-0512-00		RES,FXD,FILM:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A1R978	315-0512-00		RES,FXD,FILM:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A1R982	315-0471-00		RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
A1R983	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A1R993	315-0120-00		RES,FXD,FILM:12 OHM,5%,0.25W	57668	NTR25J-R12
A1RT236	307-0125-00		RES,THERMAL:500 OHM,10%,NTC	15454	1DB501K-220-EC
A1T902	120-1792-00		TRANSFORMER,RF:SWITCHING,INVERTER	TK0FJ	ORDER BY DESCR
A1U130	156-0534-00		MICROCKT,LINER:DUAL DIFF AMPL	02735	CA3102E-98
A1U180	156-0534-00		MICROCKT,LINER:DUAL DIFF AMPL	02735	CA3102E-98
A1U225	156-0067-00		MICROCKT,LINER:OPNL AMPL,SEL	04713	MCL741CP1
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,LINER:DUAL,INDEP PIFF AMPL	K5856	CA 3054
A1U315	156-2902-00		MICROCKT,LINER:	K5856	CA 3046
A1U325	156-2902-00		MICROCKT,LINER:	K5856	CA 3046
A1U335	156-2956-00		MICROCKT,LINER:DUAL,INDEP PIFF AMPL	K5856	CA 3054
A1U340	156-2956-00		MICROCKT,LINER:DUAL,INDEP PIFF AMPL	K5856	CA 3054
A1U370	156-2902-00		MICROCKT,LINER:	K5856	CA 3046
A1U380	156-2902-00		MICROCKT,LINER:	K5856	CA 3046
A1U415	156-2902-00		MICROCKT,LINER:	K5856	CA 3046
A1U425	156-0583-02		MICROCKT,DGTL:SUCCESSIVE APPROX RGTR,SEL	04713	MC14559BCPDS
A1U435	156-2902-00		MICROCKT,LINER:	K5856	CA 3046
A1U445	156-2902-00		MICROCKT,LINER:	K5856	CA 3046
A1U450	156-1191-01	200001	MICROCKT,LINER:DUAL BI-FET OP-AMP,8 DIP	80009	156-1191-01
A1U450	156-0853-00	200081	MICROCKT,LINER:OPNL AMPL,DUAL	04713	LM358N
A1U460	156-2956-00		MICROCKT,LINER:DUAL,INDEP PIFF AMPL	K5856	CA 3054
A1U480	156-0205-03		MICROCKT,DGTL:ECL,QUAD 2-INPUT NOR GATE	04713	MC10102 L OR P
A1U500	156-1335-00		MICROCKT,DGTL:LSTTL,DUAL RETRIGGERABLE	07263	96LS02PCQR
A1U520	156-0205-03		MICROCKT,DGTL:ECL,QUAD 2-INPUT NOR GATE	04713	MC10102 L OR P
A1U530	156-1639-00		MICROCKT,DGTL:ECL,DUAL D MA-SLAVE FF	04713	MC10H131(P OR L)
A1U537	156-0721-00		MICROCKT,DGTL:QUAD 2-INP ST NAND GATE	27014	DM74LS132N
A1U540	156-0388-00		MICROCKT,DGTL:DUAL D FLIP-FLOP	01295	SN74LS74 N OR J
A1U550	156-0205-03		MICROCKT,DGTL:ECL,QUAD 2-INPUT NOR GATE	04713	MC10102 L OR P
A1U560	156-2902-00		MICROCKT,LINER:	K5856	CA 3046

Replaceable Electrical Parts - 2210 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1U570	156-1639-00		MICROCKT,DGTL:ECL,DUAL D MA-SLAVE FF	04713	MC10H131(P OR L)
A1U580	156-0853-00		MICROCKT,LINEAR:OPNL AMPL,DUAL	04713	LM358N
A1U600	156-0724-02		MICROCKT,DGTL:HEX INV W/OC OUT,SCRN,	01295	SN74LS05NP3
A1U910	156-1627-00		MICROCKT,LINEAR:PULSE WIDTH MODULATED CONT	12969	UC494ACN
A1U920	156-0853-00		CIRCUIT,SWITCHING POWER SUPPLY,SCRN		
A1U940	156-1627-00		MICROCKT,LINEAR:OPNL AMPL,DUAL	04713	LM358N
A1U975	152-1046-00		MICROCKT,LINEAR:PULSE WIDTH MODULATED CONT	12969	UC494ACN
A1VR514	152-0166-00		CIRCUIT,SWITCHING POWER SUPPLY,SCRN		
A1VR776	152-0149-00		SEMICON DVC,DI:HV MULTR,4KVAC INPUT,12KVAC	U4144	ORDER BY DESCR
A1VR792	152-0243-00		SEMICON DVC,DI:ZEN,SI,6.2V,5%,400MW,DO-7	04713	SZ11738RL
A1VR910	152-0147-00		SEMICON DVC,DI:ZEN,SI,10V,5%,0.4W,DO-7	15238	Z5406
A1VR931	152-0317-00		SEMICON DVC,DI:ZEN,SI,15V,5%,0.4W,DO-7	04713	SZ13203 (1N965B)
A1VR939	152-0278-00		SEMICON DVC,DI:ZEN,SI,27V,5%,0.4W,DO-7	04713	SZ50622KRL
A1VR942	152-0243-00		SEMICON DVC,DI:ZEN,SI,6.2V,5%,0.4W,DO-35	04713	1N825
A1VR969	152-0278-00		SEMICON DVC,DI:ZEN,SI,3V,5%,0.4W,DO-7	80009	152-0278-00
A1W30	174-0640-00		SEMICON DVC,DI:ZEN,SI,15V,5%,0.4W,DO-7	04713	SZ13203 (1N965B)
A1W80	174-0640-00		SEMICON DVC,DI:ZEN,SI,3V,5%,0.4W,DO-7	80009	152-0278-00
A1W90	174-0639-00		CA ASSY,SP,ELEC:4,26 AWG,135MM L,RIBBON	TKOEM	820265804(135mm)
A1W90	174-0639-00		CA ASSY,SP,ELEC:6,26 AWG,110MM L,RIBBON	TKOEM	82026-5806(95mm)
A1W90	195-3407-00		LEAD,ELECTRICAL:26 AWG,3.0 L,9-3	80009	195-3407-00
A1W602	131-0566-00		BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A1W701	174-0637-00		CA ASSY,SP,ELEC:6,26 AWG,300MM L,RIBBON	TKOEM	82265806(300mm)
A1W903	174-1250-00		CA ASSY,SP,ELEC:3,26 AWG,110MM L,RIBBON	TKOEM	ORDER BY DESCR
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
A1W1001	174-1252-00		CA ASSY,SP,ELEC:4,26 AWG,150MM L,RIBBON	TKOEM	ORDER BY DESCR
A1W1002	174-1252-00		CA ASSY,SP,ELEC:4,26 AWG,150MM L,RIBBON	TKOEM	ORDER BY DESCR
A1W1003	174-0640-00		CA ASSY,SP,ELEC:4,26 AWG,135MM L,RIBBON	TKOEM	820265804(135mm)
A1W1005	174-1254-00		CA ASSY,SP,ELEC:6,26 AWG,135MM L,RIBBON	TKOEM	ORDER BY DESCR
A1W1006	174-0640-00		CA ASSY,SP,ELEC:4,26 AWG,135MM L,RIBBON	TKOEM	820265804(135mm)
A1W1007	174-0640-00		CA ASSY,SP,ELEC:4,26 AWG,135MM L,RIBBON	TKOEM	820265804(135mm)
A1W1008	174-1254-00		CA ASSY,SP,ELEC:6,26 AWG,135MM L,RIBBON	TKOEM	ORDER BY DESCR

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A2	671-0668-00		CIRCUIT BD ASSY:ATTENUATOR/T.B.	80009	671-0668-00
A2AT1	260-2345-00		SWITCH ASSEMBLY:DPDT,ATTENUATOR	S4239	NOBLE E773-1019E
A2AT51	260-2345-00		SWITCH ASSEMBLY:DPDT,ATTENUATOR	S4239	NOBLE E773-1019E
A2C6	283-0000-00		CAP,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-610-Y5U0102P
A2C8	281-0812-00		CAP,FXD,CER DI:1000PF,10%,100V	04222	MA101C102KAA
A2C13	281-0775-01		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
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	MA101C102KAA
A2C32	281-0773-00		CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A2C33	281-0773-00		CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A2C35	281-0812-00		CAP,FXD,CER DI:1000PF,10%,100V	04222	MA101C102KAA
A2C38	281-0812-00		CAP,FXD,CER DI:1000PF,10%,100V	04222	MA101C102KAA
A2C56	283-0000-00		CAP,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-610-Y5U0102P
A2C58	281-0812-00		CAP,FXD,CER DI:1000PF,10%,100V	04222	MA101C102KAA
A2C63	281-0775-01		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
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	MA101C102KAA
A2C82	281-0773-00		CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A2C83	281-0773-00		CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A2C85	281-0812-00		CAP,FXD,CER DI:1000PF,10%,100V	04222	MA101C102KAA
A2C88	281-0812-00		CAP,FXD,CER DI:1000PF,10%,100V	04222	MA101C102KAA
A2C93	290-1159-00		CAP,FXD,ELCTLT:1000UF,20%,16V	TKOED	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	TKOED	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	290-1153-00		CAP,FXD,ELCTLT:47UF,+50-10%,10V	K8996	030-24479
A2C688	285-1408-00		CAP,FXD,MTLZD:10UF,1%,250V,AXIAL,TUB,MI	TKOED	ORDER BY DESC
A2C690	281-0775-01		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
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	TKOED	ORDER BY DESC
A2C702	285-1408-00		CAP,FXD,MTLZD:10UF,1%,250V,AXIAL,TUB,MI	TKOED	ORDER BY DESC
A2C703	281-0207-00		CAP,VAR,PLASTIC:2-18PF,100V	52769	GXA 18000
A2C704	283-0674-00		CAP,FXD,MICA DI:85PF,1%,500V	00853	D155F850F0
A2C705	281-0813-00		CAP,FXD,CER DI:0.047UF,20%,50V	05397	C412C473M5V2CA
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	05397	T320A474K035AS
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	20932	401E0100AD121J
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	MA101A201JAA
A2C733	281-0758-00		CAP,FXD,CER DI:15PF,20%,100V	04222	SA102A150MAA
A2C734	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	MA101A201JAA
A2C755	281-0809-00		CAP,FXD,CER DI:200 PF,5%,100V	04222	MA101A201JAA
A2C767	281-0786-00		CAP,FXD,CER DI:150PF,10%,100V	04222	MA101A151KAA
A2C773	281-0809-00		CAP,FXD,CER DI:200 PF,5%,100V	04222	MA101A201JAA

Replaceable Electrical Parts - 2210 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Discnt	Name & Description	Mfr. Code	Mfr. Part No.
A2C774	281-0775-01		CAP, FXD, CER DI: 0.1UF, 20%, 50V	04222	SA105E104MAA
A2CR7	152-0324-00		SEMICON DVC, DI: SW, SI, 35V, 0.1A, DO-7	14552	MT5128
A2CR57	152-0324-00		SEMICON DVC, DI: SW, SI, 35V, 0.1A, DO-7	14552	MT5128
A2CR566	152-0141-02		SEMICON DVC, DI: SW, SI, 30V, 150MA, 30V, DO-35	03508	DA2527 (1N4152)
A2CR676	152-0141-02		SEMICON DVC, DI: SW, SI, 30V, 150MA, 30V, DO-35	03508	DA2527 (1N4152)
A2CR677	152-0141-02		SEMICON DVC, DI: SW, SI, 30V, 150MA, 30V, DO-35	03508	DA2527 (1N4152)
A2CR678	152-0141-02		SEMICON DVC, DI: SW, SI, 30V, 150MA, 30V, DO-35	03508	DA2527 (1N4152)
A2CR679	152-0141-02		SEMICON DVC, DI: SW, SI, 30V, 150MA, 30V, DO-35	03508	DA2527 (1N4152)
A2CR686	152-0141-02		SEMICON DVC, DI: SW, SI, 30V, 150MA, 30V, DO-35	03508	DA2527 (1N4152)
A2CR698	152-0322-00		SEMICON DVC, DI: SCHOTTKY, SI, 15V, 1.2PF, DO-35	50434	5082-2672
A2CR699	152-0322-00		SEMICON DVC, DI: SCHOTTKY, SI, 15V, 1.2PF, DO-35	50434	5082-2672
A2CR732	152-0141-02		SEMICON DVC, DI: SW, SI, 30V, 150MA, 30V, DO-35	03508	DA2527 (1N4152)
A2CR747	152-0141-02		SEMICON DVC, DI: SW, SI, 30V, 150MA, 30V, DO-35	03508	DA2527 (1N4152)
A2CR748	152-0141-02		SEMICON DVC, DI: SW, SI, 30V, 150MA, 30V, DO-35	03508	DA2527 (1N4152)
A2CR755	152-0141-02		SEMICON DVC, DI: SW, SI, 30V, 150MA, 30V, DO-35	03508	DA2527 (1N4152)
A2CR758	152-0141-02		SEMICON DVC, DI: SW, SI, 30V, 150MA, 30V, DO-35	03508	DA2527 (1N4152)
A2CR761	152-0141-02		SEMICON DVC, DI: SW, SI, 30V, 150MA, 30V, DO-35	03508	DA2527 (1N4152)
A2CR762	152-0141-02		SEMICON DVC, DI: SW, SI, 30V, 150MA, 30V, DO-35	03508	DA2527 (1N4152)
A2CR769	152-0141-02		SEMICON DVC, DI: SW, SI, 30V, 150MA, 30V, DO-35	03508	DA2527 (1N4152)
A2CR773	152-0141-02		SEMICON DVC, DI: SW, SI, 30V, 150MA, 30V, DO-35	03508	DA2527 (1N4152)
A2CR774	152-0141-02		SEMICON DVC, DI: SW, SI, 30V, 150MA, 30V, DO-35	03508	DA2527 (1N4152)
A2E90	276-0752-00		CORE, EM: FERRITE	34899	2743001111
A2E91	276-0752-00		CORE, EM: FERRITE	34899	2743001111
A2E92	276-0752-00		CORE, EM: FERRITE	34899	2743001111
A2E93	276-0752-00		CORE, EM: FERRITE	34899	2743001111
A2J7	204-1034-00		CONN BODY, RCPT: 1 X 6, WITH SOLDER TAILS	TKOEM	52011-0610
A2J29	136-0929-00	200259	SKT, PL-IN ELEK: MICROCIRCUIT, 14 PIN	TK00A	WPT DIR-14
A2J30	204-1033-00		CONN BODY, RCPT: 1 X 4, WITH SOLDER TAILS	TKOEM	52011-0410
A2J79	136-0929-00	200259	SKT, PL-IN ELEK: MICROCIRCUIT, 14 PIN	TK00A	WPT DIR-14
A2J80	204-1033-00		CONN BODY, RCPT: 1 X 4, WITH SOLDER TAILS	TKOEM	52011-0410
A2J90	204-1034-00		CONN BODY, RCPT: 1 X 6, WITH SOLDER TAILS	TKOEM	52011-0610
A2J701	204-1034-00		CONN BODY, RCPT: 1 X 6, WITH SOLDER TAILS	TKOEM	52011-0610
A2J755	204-1033-00		CONN BODY, RCPT: 1 X 4, WITH SOLDER TAILS	TKOEM	52011-0410
A2L93	120-1631-00		COIL, RF: FXD, 210UH	TK00A	ORDER BY DESC
A2L96	120-1631-00		COIL, RF: FXD, 210UH	TK00A	ORDER BY DESC
A2L712	120-1631-00		COIL, RF: FXD, 210UH	TK00A	ORDER BY DESC
A2L713	120-1631-00		COIL, RF: FXD, 210UH	TK00A	ORDER BY DESC
A2Q13	151-1235-00		TRANSISTOR: JFET, N-CHAN, DUAL HYBRID	K7068	2N5911
A2Q63	151-1235-00		TRANSISTOR: JFET, N-CHAN, DUAL HYBRID	K7068	2N5911
A2Q670	151-0190-00		TRANSISTOR: NPN, SI, TO-92	80009	151-0190-00
A2Q680	151-0190-00		TRANSISTOR: NPN, SI, TO-92	80009	151-0190-00
A2Q681	151-0712-00		TRANSISTOR: PNP, SI, TO-92	04713	SPS8223
A2Q684	151-0190-00		TRANSISTOR: NPN, SI, TO-92	80009	151-0190-00
A2Q690	151-0424-00		TRANSISTOR: NPN, SI, TO-92	04713	SPS8246
A2Q694	151-0188-00		TRANSISTOR: PNP, SI, TO-92	80009	151-0188-00
A2Q698	151-1042-00		SEMICON DVC SE: FET, SI, TO-92	80009	151-1042-00
A2Q699	151-0736-00		TRANSISTOR: NPN, SI, TO-92	80009	151-0736-00
A2Q701	151-0424-00		TRANSISTOR: NPN, SI, TO-92	04713	SPS8246
A2Q702	151-0188-00		TRANSISTOR: PNP, SI, TO-92	80009	151-0188-00
A2Q704	151-1042-00		SEMICON DVC SE: FET, SI, TO-92	80009	151-1042-00
A2Q706	151-0736-00		TRANSISTOR: NPN, SI, TO-92	80009	151-0736-00
A2Q732	151-0190-00		TRANSISTOR: NPN, SI, TO-92	80009	151-0190-00
A2Q737	151-0188-00		TRANSISTOR: PNP, SI, TO-92	80009	151-0188-00
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	80009	151-0188-00
A2Q759	151-0188-00		TRANSISTOR: PNP, SI, TO-92	80009	151-0188-00
A2Q760	151-0188-00		TRANSISTOR: PNP, SI, TO-92	80009	151-0188-00

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Discont	Name & Description	Mfr. Code	Mfr. Part No.
A2R3	315-0330-00		RES,FXD,FILM:33 OHM,5%,0.25W	19701	5043CX33R00J
A2R5	322-0481-01		RES,FXD,FILM:1M OHM, 0.5%,0.25W,TC=TO	75042	CEBT0-1004D
A2R6	315-0474-00		RES,FXD,FILM:470K OHM,5%,0.25W	19701	5043CX470KQJ92U
A2R7	315-0470-00		RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A2R8	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A2R9	315-0330-00		RES,FXD,FILM:33 OHM,5%,0.25W	19701	5043CX33R00J
A2R13	315-0470-00		RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A2R14	315-0200-00		RES,FXD,FILM:20 OHM,5%,0.25W	19701	5043CX20R00J
A2R15	315-0200-00		RES,FXD,FILM:20 OHM,5%,0.25W	19701	5043CX20R00J
A2R22	321-0210-00		RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=TO	19701	5033ED1K50F
A2R23	321-0210-00		RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=TO	19701	5033ED1K50F
A2R29	321-0068-00		RES,FXD,FILM:49.9 OHM,0.5%,0.125W,TC=TO	91637	CMF55116649R90F
A2R30	315-0472-00		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A2R31	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A2R32	315-0472-00		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
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=TO	07716	CEAD309R0F
A2R36	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A2R37	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A2R38	321-0144-00		RES,FXD,FILM:309 OHM,1%,0.125W,TC=TO	07716	CEAD309R0F
A2R39	315-0242-00		RES,FXD,FILM:2.4K OHM,5%,0.25W	57668	NTR25J-E02K4
A2R41	321-0154-00		RES,FXD,FILM:392 OHM,1%,0.125W,TC=TO	07716	CEAD392R0F
A2R42	315-0333-00		RES,FXD,FILM:33K OHM,5%,0.25W	57668	NTR25J-E33K0
A2R53	315-0330-00		RES,FXD,FILM:33 OHM,5%,0.25W	19701	5043CX33R00J
A2R55	322-0481-01		RES,FXD,FILM:1M OHM, 0.5%,0.25W,TC=TO	75042	CEBT0-1004D
A2R56	315-0474-00		RES,FXD,FILM:470K OHM,5%,0.25W	19701	5043CX470KQJ92U
A2R57	315-0470-00		RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A2R58	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A2R59	315-0330-00		RES,FXD,FILM:33 OHM,5%,0.25W	19701	5043CX33R00J
A2R63	315-0470-00		RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A2R64	315-0200-00		RES,FXD,FILM:20 OHM,5%,0.25W	19701	5043CX20R00J
A2R65	315-0200-00		RES,FXD,FILM:20 OHM,5%,0.25W	19701	5043CX20R00J
A2R72	321-0210-00		RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=TO	19701	5033ED1K50F
A2R73	321-0210-00		RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=TO	19701	5033ED1K50F
A2R78	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A2R79	321-0068-00		RES,FXD,FILM:49.9 OHM,0.5%,0.125W,TC=TO	91637	CMF55116649R90F
A2R80	315-0472-00		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A2R81	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A2R82	315-0472-00		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
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=TO	07716	CEAD309R0F
A2R86	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A2R87	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A2R88	321-0144-00		RES,FXD,FILM:309 OHM,1%,0.125W,TC=TO	07716	CEAD309R0F
A2R91	321-0154-00		RES,FXD,FILM:392 OHM,1%,0.125W,TC=TO	07716	CEAD392R0F
A2R93	315-0100-00		RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10R00J
A2R96	307-0113-00		RES,FXD,CMPSN:5.1 OHM,5%,0.25W	01121	CB51G5
A2R670	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A2R671	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A2R675	315-0201-00		RES,FXD,FILM:200 OHM,5%,0.25W	57668	NTR25J-E200E
A2R676	315-0682-00		RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
A2R677	315-0625-00		RES,FXD,FILM:6.2M OHM,5%,0.25W	01121	CB6255
A2R678	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A2R679	315-0393-00		RES,FXD,FILM:39K OHM,5%,0.25W	57668	NTR25J-E39K0
A2R680	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A2R681	315-0433-00		RES,FXD,FILM:43K OHM,5%,0.25W	19701	5043CX43K00J
A2R682	315-0243-00		RES,FXD,FILM:24K OHM,5%,0.25W	57668	NTR25J-E24K0
A2R683	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K

Replaceable Electrical Parts - 2210 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A2R684	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A2R685	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A2R686	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
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	19701	5043CX10RR00J
A2R689	321-0433-00		RES,FXD,FILM:316K OHM,1%,0.125W,TC=TO	07716	CEAD31602F
A2R690	315-0392-00		RES,FXD,FILM:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A2R693	315-0201-00		RES,FXD,FILM:200 OHM,5%,0.25W	57668	NTR25J-E200E
A2R694	315-0392-00		RES,FXD,FILM:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A2R695	315-0562-00		RES,FXD,FILM:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
A2R696	315-0203-00		RES,FXD,FILM:20K OHM,5%,0.25W	57668	NTR25J-E 20K
A2R698	315-0151-00		RES,FXD,FILM:150 OHM,5%,0.25W	57668	NTR25J-E150E
A2R699	321-0274-00		RES,FXD,FILM:6.98K OHM,1%,0.125W,TC=TO	19701	5043ED6K980F
A2R700	315-0100-00		RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J
A2R701	307-0780-01		RES NTWK,FXD,FI:TIMING	80009	307-0780-01
A2R702	322-0519-01		RES,FXD,FILM:2.49M OHM,0.5%,0.25W,TC=TO	07716	CCAD24903D
A2R703	315-0100-00		RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J
A2R704	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A2R705	315-0151-00		RES,FXD,FILM:150 OHM,5%,0.25W	57668	NTR25J-E150E
A2R706	321-0318-00		RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=TO	19701	5033ED20K00F
A2R707	315-0392-00		RES,FXD,FILM:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A2R708	315-0201-00		RES,FXD,FILM:200 OHM,5%,0.25W	57668	NTR25J-E200E
A2R709	315-0562-00		RES,FXD,FILM:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
A2R711	315-0302-00		RES,FXD,FILM:3K OHM,5%,0.25W	57668	NTR25J-E03K0
A2R712	321-0231-00		RES,FXD,FILM:2.49K OHM,1%,0.125W,TC=TO	19701	5033ED2K49F
A2R713	321-0231-00		RES,FXD,FILM:2.49K OHM,1%,0.125W,TC=TO	19701	5033ED2K49F
A2R714	321-0235-00		RES,FXD,FILM:2.74K OHM,1%,0.125W,TC=TO	07716	CEAD27400F
A2R715	321-0231-00		RES,FXD,FILM:2.49K OHM,1%,0.125W,TC=TO	19701	5033ED2K49F
A2R716	321-0225-00		RES,FXD,FILM:2.15K OHM,1%,0.125W,TC=TO	19701	5033ED2K15F
A2R717	321-0306-00		RES,FXD,FILM:15.0K OHM,1%,0.125W,TC=TO	19701	5033ED15J00F
A2R718	321-0306-00		RES,FXD,FILM:15.0K OHM,1%,0.125W,TC=TO	19701	5033ED15J00F
A2R719	315-0330-00		RES,FXD,FILM:33 OHM,5%,0.25W	19701	5043CX33R00J
A2R720	315-0201-00		RES,FXD,FILM:200 OHM,5%,0.25W	57668	NTR25J-E200E
A2R721	311-2423-00		RES,VAR,NONWW:PANEL,470 OHM,20%,0.2W	80009	311-2423-00
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	57668	NTR25J-E100K
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 DESCR
A2R732	321-0251-00		RES,FXD,FILM:4.02K OHM,1%,0.125W,TC=TO	19701	5033ED4K020F
A2R733	321-0231-00		RES,FXD,FILM:2.49K OHM,1%,0.125W,TC=TO	19701	5033ED2K49F
A2R734	315-0272-00		RES,FXD,FILM:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
A2R735	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A2R736	311-2421-00		RES,VAR,NONWW:TRMR,1K	K8788	ORDER BY DESCR
A2R737	321-0197-00		RES,FXD,FILM:1.10K OHM,1%,0.125W,TC=TO	07716	CEAD11000F
A2R738	321-0210-00		RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=TO	19701	5033ED1K50F
A2R739	321-0210-00		RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=TO	19701	5033ED1K50F
A2R740	321-0274-00		RES,FXD,FILM:6.98K OHM,1%,0.125W,TC=TO	19701	5043ED6K980F
A2R741	321-0210-00		RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=TO	19701	5033ED1K50F
A2R742	321-0210-00		RES,FXD,FILM:1.50K OHM,1%,0.125W,TC=TO	19701	5033ED1K50F
A2R743	321-0177-00		RES,FXD,FILM:681 OHM,1%,0.125W,TC=TO	07716	CEAD681R0F
A2R744	321-0177-00		RES,FXD,FILM:681 OHM,1%,0.125W,TC=TO	07716	CEAD681R0F
A2R745	321-0177-00		RES,FXD,FILM:681 OHM,1%,0.125W,TC=TO	07716	CEAD681R0F
A2R746	315-0472-00		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A2R747	315-0431-00		RES,FXD,FILM:430 OHM,5%,0.25W	19701	5043CX430R0J
A2R748	315-0431-00		RES,FXD,FILM:430 OHM,5%,0.25W	19701	5043CX430R0J
A2R749	321-0098-00		RES,FXD,FILM:102 OHM,1%,0.125W,TC=TO	07716	CEAD102R0F
A2R750	321-0318-00		RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=TO	19701	5033ED20K00F
A2R751	321-0178-00		RES,FXD,FILM:698 OHM,1%,0.125W,TC=TO	07716	CEAD698R0F

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A2R752	321-0178-00		RES,FXD,FILM:698 OHM,1%,0.125W,TC=TO	07716	CEAD698ROF
A2R753	321-0178-00		RES,FXD,FILM:698 OHM,1%,0.125W,TC=TO	07716	CEAD698ROF
A2R754	321-0179-00		RES,FXD,FILM:715 OHM,1%,0.125W,TC=TO	07716	CEAD715ROF
A2R755	315-0132-00		RES,FXD,FILM:1.3K OHM,5%,0.25W	57668	NTR25J-E01K3
A2R756	315-0132-00		RES,FXD,FILM:1.3K OHM,5%,0.25W	57668	NTR25J-E01K3
A2R757	321-0172-00		RES,FXD,FILM:604 OHM,1%,0.125W,TC=TO	19701	5033ED604ROF
A2R758	321-0163-00		RES,FXD,FILM:487 OHM,1%,0.125W,TC=TO	07716	CEAD487ROF
A2R759	315-0222-00		RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A2R760	315-0222-00		RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A2R761	321-0225-00		RES,FXD,FILM:2.15K OHM,1%,0.125W,TC=TO	19701	5033ED2K15F
A2R762	321-0225-00		RES,FXD,FILM:2.15K OHM,1%,0.125W,TC=TO	19701	5033ED2K15F
A2R763	321-0216-00		RES,FXD,FILM:1.74K OHM,1%,0.125W,TC=TO	07716	CEAD17400F
A2R765	321-0274-00		RES,FXD,FILM:6.98K OHM,1%,0.125W,TC=TO	19701	5043ED6K980F
A2R766	321-0274-00		RES,FXD,FILM:6.98K OHM,1%,0.125W,TC=TO	19701	5043ED6K980F
A2R767	321-0098-00		RES,FXD,FILM:102 OHM,1%,0.125W,TC=TO	07716	CEAD102ROF
A2R768	321-0274-00		RES,FXD,FILM:6.98K OHM,1%,0.125W,TC=TO	19701	5043ED6K980F
A2R769	321-0318-00		RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=TO	19701	5033ED20K00F
A2R770	321-0242-00		RES,FXD,FILM:3.24K OHM,1%,0.125W,TC=TO	19701	5043ED3K240F
A2R771	321-0225-00		RES,FXD,FILM:2.15K OHM,1%,0.125W,TC=TO	19701	5033ED2K15F
A2R772	321-0225-00		RES,FXD,FILM:2.15K OHM,1%,0.125W,TC=TO	19701	5033ED2K15F
A2R773	321-0178-00		RES,FXD,FILM:698 OHM,1%,0.125W,TC=TO	07716	CEAD698ROF
A2R774	321-0178-00		RES,FXD,FILM:698 OHM,1%,0.125W,TC=TO	07716	CEAD698ROF
A2R775	311-2421-00		RES,VAR,NONW:TRMR,1K	K8788	ORDER BY DESCR
A2R777	311-2422-00		RES,VAR,NONW:TRMR,100 OHM	K8788	ORDER BY DESCR
A2R782	311-2353-00		RES,VAR,NONW:TRMR,470 OHM,0.5W	K8788	311235400
A2S701	260-2417-00		SWITCH,ROTARY:TIMEBASE,23 POS	U3771	ORDER BY DESCR
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	156-2902-00		MICROCKT,LINEAR:	K5856	CA 3046
A2U715	156-0067-00		MICROCKT,LINEAR:OPNL AMPL,SEL	04713	MC1741CP1
A2U745	156-2902-00	200001	MICROCKT,LINEAR:	K5856	CA 3046
A2U745	156-0048-00	200259	MICROCKT,LINEAR:5 XSTR ARRAY	02735	CA3046
A2U755	156-2902-00	200001	MICROCKT,LINEAR:	K5856	CA 3046
A2U755	156-0048-00	200259	MICROCKT,LINEAR:5 XSTR ARRAY	02735	CA3046
A2VR719	152-0744-00		SEMICON DVC,DI:ZEN,SI,3.6V,5%,0.4W,DO-7	15238	IN747ATK
A2W755	174-0640-00		CA ASSY,SP,ELEC:4,26 AWG,135MM L,RIBBON	TKOEM	820265804(135mm)
A2W1009	174-1256-00		CA ASSY,SP,ELEC:6,26 AWG,180MM L,RIBBON	TKOEM	ORDER BY DESCR
A2W1010	174-1255-00		CA ASSY,SP,ELEC:6,26 AWG,150MM L,RIBBON	TKOEM	ORDER BY DESCR

Replaceable Electrical Parts - 2210 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A3	671-0669-00		CIRCUIT BD ASSY:FRONT PANEL	80009	671-0669-00
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
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	TK00Z	MKT1-50
A3C377	285-1385-00		CAP,FXD,PLASTIC:43PF,2.5%,630V	K7779	B31063-A6430-H6
A3C378	285-1425-00		CAP,FXD,PLASTIC:390PF,2.5%,160V	K7779	B33063-B1391-H7
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	MA205C273MAA
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		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A3CR534	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A3CR537	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A3CR538	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A3DS370	150-1187-00		LT EMITTING DIO:GREEN	TK00A	LN31GPHLEXLED5GS
A3DS560	150-1187-00		LT EMITTING DIO:GREEN	TK00A	LN31GPHLEXLED5GS
A3Q370	151-1042-00		SEMICON DVC SE:FET,SI,TO-92	80009	151-1042-00
A3Q725	151-0188-00		TRANSISTOR:PMP,SI,TO-92	80009	151-0188-00
A3Q802	151-0190-00		TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A3R1	315-0470-00		RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A3R2	315-0105-00		RES,FXD,FILM:1M OHM,5%,0.25W	19701	5043CX1M000J
A3R4	315-0100-00		RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10R00J
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	57668	NTR25J-E47E0
A3R52	315-0105-00		RES,FXD,FILM:1M OHM,5%,0.25W	19701	5043CX1M000J
A3R54	315-0100-00		RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10R00J
A3R84	311-2368-00		RES,VAR,NONWM:TRMR,47K OHM,0.5W	K8788	TC10-LV10-47K/A
A3R89	315-0222-00		RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A3R92	315-0333-00		RES,FXD,FILM:33K OHM,5%,0.25W	57668	NTR25J-E33K0
A3R94	315-0333-00		RES,FXD,FILM:33K OHM,5%,0.25W	57668	NTR25J-E33K0
A3R113	321-0251-00		RES,FXD,FILM:4.02K OHM,1%,0.125W,TC=TO	19701	5033ED4K020F
A3R123	311-2366-00		RES,VAR,NONWM:PNL,470 OHM,20%,0.2W	K8996	PP17/000HFAQA234
A3R163	321-0251-00		RES,FXD,FILM:4.02K OHM,1%,0.125W,TC=TO	19701	5033ED4K020F
A3R173	311-2366-00		RES,VAR,NONWM:PNL,470 OHM,20%,0.2W	K8996	PP17/000HFAQA234
A3R280	311-2362-00		RES,VAR,NONWM:PNL,4.7K OHM,20%,0.2W	K8996	PP17/000HFAQA364
A3R365	321-0172-00		RES,FXD,FILM:604 OHM,1%,0.125W,TC=TO	19701	5033ED604R0F
A3R370	315-0470-00		RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A3R371	315-0470-00		RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A3R372	315-0392-00		RES,FXD,FILM:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
A3R373	315-0202-00		RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
A3R376	315-0101-00		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
A3R377	315-0394-00		RES,FXD,FILM:390K OHM,5%,0.25W	57668	NTR25J-E390K
A3R378	315-0433-00		RES,FXD,FILM:43K OHM,5%,0.25W	19701	5043CX43K00J
A3R379	315-0470-00		RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A3R382	315-0470-00		RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A3R383	315-0564-00		RES,FXD,FILM:560K OHM,5%,0.25W	19701	5043CX560K0J
A3R426	311-2362-00		RES,VAR,NONWM:PNL,4.7K OHM,20%,0.2W	K8996	PP17/000HFAQA364
A3R511	311-2360-00		RES,VAR,NONWM:PNL,47K OHM,20%,0.2W	K8996	PP17/000HFAQA494
A3R518	315-0912-00		RES,FXD,FILM:9.1K OHM,5%,0.25W	57668	NTR25J-E09K1
A3R724	315-0751-00		RES,FXD,FILM:750 OHM,5%,0.25W	57668	NTR25J-E750E
A3R725	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A3R726	311-2366-00		RES,VAR,NONWM:PNL,470 OHM,20%,0.2W	K8996	PP17/000HFAQA234

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Discont	Name & Description	Mfr. Code	Mfr. Part No.
A3R727	321-0177-00		RES,FXD,FILM:681 OHM,1%,0.125W,TC=TO	07716	CEAD681ROF
A3R728	321-0318-00		RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=TO	19701	5033ED20K00F
A3R729	311-2362-00		RES,VAR,NONWW:P.NL,4.7K OHM,20%,0.2W	K8996	PP17/000HFAOA364
A3R800	315-0682-00		RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
A3R801	315-0202-00		RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
A3R802	311-2359-00		RES,VAR,NONWW:P.NL,10K OHM,20%,0.2W	K8996	PP17000HGAOA4110
A3R803	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A3R807	315-0203-00		RES,FXD,FILM:20K OHM,5%,0.25W	57668	NTR25J-E 20K
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	57668	NTR25J-E200E
A3S90	260-2291-00		SWITCH,SLIDE:DPDT,250MA,100VAC	U3771	607/TK 2 POS
A3S101	260-2293-00		SWITCH,SLIDE:DPTT,250MA,100VAC	U3771	607/TEK 3 POS
A3S201	260-2293-00		SWITCH,SLIDE:DPTT,250MA,100VAC	U3771	607/TEK 3 POS
A3S260	260-2291-00		SWITCH,SLIDE:DPDT,250MA,100VAC	U3771	607/TK 2 POS
A3S380	260-2292-00		SWITCH,SLIDE:DP4T,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:DP4T,250MA,100VAC	U3771	607/TEK 4 POS
A3S401	260-2292-00		SWITCH,SLIDE:DP4T,250MA,100VAC	U3771	607/TEK 4 POS
A3S505	260-2290-00		SWITCH,PUSH:1 BUTTON,1 POLE,MOMENTARY	TK0EA	SKECCAA061A
A3S545	260-2293-00		SWITCH,SLIDE:DPTT,250MA,100VAC	U3771	607/TEK 3 POS
A3S550	260-2293-00		SWITCH,SLIDE:DPTT,250MA,100VAC	U3771	607/TEK 3 POS
A3S555	260-2292-00		SWITCH,SLIDE:DP4T,250MA,100VAC	U3771	607/TEK 4 POS
A3S603	260-2293-00		SWITCH,SLIDE:DPTT,250MA,100VAC	U3771	607/TEK 3 POS
A3W1	174-1253-00		CA ASSY,SP,ELEC:6,26 AWG,80MM L,RIBBON	TKOEM	ORDER BY DESCR
A3W2	174-0639-00		CA ASSY,SP,ELEC:6,26 AWG,110MM L,RIBBON	TKOEM	82026-5806(95mm)
A3W3	174-1253-00		CA ASSY,SP,ELEC:6,26 AWG,80MM L,RIBBON	TKOEM	ORDER BY DESCR
A3W4	174-0639-00		CA ASSY,SP,ELEC:6,26 AWG,110MM L,RIBBON	TKOEM	82026-5806(95mm)
A3W5	174-1253-00		CA ASSY,SP,ELEC:6,26 AWG,80MM L,RIBBON	TKOEM	ORDER BY DESCR
A3W6	174-0635-00		CA ASSY,SP,ELEC:6,26 AWG,120MM L,RIBBON	TKOEM	82265806(120mm)
A3W7	174-1255-00		CA ASSY,SP,ELEC:6,26 AWG,150MM L,RIBBON	TKOEM	ORDER BY DESCR

Replaceable Electrical Parts - 2210 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Discont	Name & Description	Mfr. Code	Mfr. Part No.
A4	670-9939-05			CIRCUIT BD ASSY:MAIN INLET	80009	670-9939-05
A4C900	290-1158-00			CAP,FXD,ELCTLT:2200UF,20%,80V	TKOED	ORDER BY DESCR
A4C903	285-1192-00			CAP,FXD,PPR DI:0.0022 UF,20%,250VAC	TK0515	PME271Y510
A4C904	285-1192-00			CAP,FXD,PPR DI:0.0022 UF,20%,250VAC	TK0515	PME271Y510
A4C905	285-1252-00			CAP,FXD,PLASTIC:0.15UF,10%,250VAC	D5243	F1772-415-2000
A4CR901	152-0066-00			SEMICON DVC,DI:RECT,SI,400V,1A,DO-41	05828	GP10G-020
A4CR902	152-0066-00			SEMICON DVC,DI:RECT,SI,400V,1A,DO-41	05828	GP10G-020
A4CR903	152-0066-00			SEMICON DVC,DI:RECT,SI,400V,1A,DO-41	05828	GP10G-020
A4CR904	152-0066-00			SEMICON DVC,DI:RECT,SI,400V,1A,DO-41	05828	GP10G-020
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	204-1038-00
A4L901	108-1416-00	200001	200258	COIL,RF:POWER INDUCTOR,300UH-400UH,3A	80009	108-1416-00
A4L901	108-1375-00	200259		COIL,RF:FXD,82UH,1A	TK00A	RL-1218-820K-1A
A4L902	108-1416-00	200001	200258	COIL,RF:POWER INDUCTOR,300UH-400UH,3A	80009	108-1416-00
A4L902	108-1375-00	200259		COIL,RF:FXD,82UH,1A	TK00A	RL-1218-820K-1A
A4Q900	151-0350-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6700
A4R902	315-0473-00			RES,FXD,FILM:47K OHM,5%,0.25W	57668	NTR25J-E47K0
A4R903	315-0243-00			RES,FXD,FILM:24K OHM,5%,0.25W	57668	NTR25J-E24K0
A4R904	315-0562-00			RES,FXD,FILM:5.6K OHM,5%,0.25W	57668	NTR25J-E05K6
A4R905	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A4R906	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25W	19701	5043CX1M000J
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 No.	Tektronix Part No.	Serial/Assembly No. Effective Discnt	Name & Description	Mfr. Code	Mfr. Part No.
A5	670-9938-05		CIRCUIT BD ASSY:FOCUS CONTROL	80009	670-9938-05
A5R893	311-2357-00		RES,VAR,NONMW:PNL,2.2M OHM,20%,0.25W	TK00C	ORDER BY DESCR
A5W893	-----		(NOT REPLACEABLE - ORDER A5)		

Replaceable Electrical Parts - 2210 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A10	671-0670-00		CIRCUIT BD ASSY:STORAGE	80009	671-0670-00
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	281-0810-00		CAP,FXD,CER DI:5.6PF,+/-0.5PF,100V	04222	MA101A5R6DAA
A10C1004	281-0810-00		CAP,FXD,CER DI:5.6PF,+/-0.5PF,100V	04222	MA101A5R6DAA
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
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
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
A10C1509	281-0775-01		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1510	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
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
A10C1517	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
A10C1522	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
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
A10C1756	283-0999-00		CAP,FXD,CER DI:0.02UF,+100/-25%,50V	80009	283-0999-00
A10C1757	283-0999-00		CAP,FXD,CER DI:0.02UF,+100/-25%,50V	80009	283-0999-00
A10C1758	281-0775-01		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C1759	283-0999-00		CAP,FXD,CER DI:0.02UF,+100/-25%,50V	80009	283-0999-00
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
A10C1763	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
A10C1767	283-0999-00		CAP,FXD,CER DI:0.02UF,+100/-25%,50V	80009	283-0999-00
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
A10C2004	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
A10C2250	281-0772-00		CAP,FXD,CER DI:4700PF,10%,100V	04222	MA201C472KAA
A10C2251	281-0772-00		CAP,FXD,CER DI:4700PF,10%,100V	04222	MA201C472KAA
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

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Discnt	Name & Description	Mfr. Code	Mfr. Part No.
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
A10C2500	281-0316-00		CAP,VAR,PLASTIC:1-4PF,200V	80009	281-0316-00
A10C2501	281-0773-00		CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A10C2503	281-0814-00		CAP,FXD,CER DI:100 PF,10%,100V	04222	MA101A101KAA
A10C2505	281-0775-01		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C2506	281-0775-01		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C2507	281-0775-01		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C2510	131-0566-00		BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A10C3001	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
A10C3201	290-0246-00		CAP,FXD,ELCTL:3.3UF,10%,15V	12954	D3R3EA15K1
A10C3202	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	80009	283-0988-00
A10C7001	281-0775-01		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7002	283-0999-00		CAP,FXD,CER DI:0.02UF,+100/-25%,50V	80009	283-0999-00
A10C7003	281-0775-01		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A10C7004	281-0775-01		CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
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	283-0988-00		CAP,FXD,CER,DI:0.33UF,10%,160V	80009	283-0988-00
A10C7010	283-0988-00		CAP,FXD,CER,DI:0.33UF,10%,160V	80009	283-0988-00
A10C7011	283-0999-00		CAP,FXD,CER DI:0.02UF,+100/-25%,50V	80009	283-0999-00
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	283-0999-00		CAP,FXD,CER DI:0.02UF,+100/-25%,50V	80009	283-0999-00
A10C7018	290-1153-00		CAP,FXD,ELCTL:47UF,+50-10%,10V	K8996	030-24479
A10C7066	290-1153-00		CAP,FXD,ELCTL:47UF,+50-10%,10V	K8996	030-24479
A10C7501	281-0865-00		CAP,FXD,CER DI:1000PF,5%,100V	04222	MA101A102JAA
A10C7502	281-0810-00		CAP,FXD,CER DI:5.6PF,+/-0.5PF,100V	04222	MA101A5R6DAA
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,ELCTL:3.3UF,10%,15V	12954	D3R3EA15K1
A10CR1001	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR1002	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR1003	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR1004	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR1005	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR1006	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR1007	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR1008	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR1009	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR1010	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR1011	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR1012	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR1013	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR1014	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR1015	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR1501	152-1055-00		SEMICON DVC DI:Schottky,40V,0.5 AMP	TKOEN	MBR-040
A10CR1502	152-1055-00		SEMICON DVC DI:Schottky,40V,0.5 AMP	TKOEN	MBR-040
A10CR1503	152-1055-00		SEMICON DVC DI:Schottky,40V,0.5 AMP	TKOEN	MBR-040
A10CR1504	152-1055-00		SEMICON DVC DI:Schottky,40V,0.5 AMP	TKOEN	MBR-040

Replaceable Electrical Parts - 2210 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Discnt	Name & Description	Mfr. Code	Mfr. Part No.
A10CR3200	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR7000	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR7001	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR7002	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR7003	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR7004	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR7005	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR7006	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR7007	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR7008	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR7011	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR7012	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR7501	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10CR7502	152-0141-02		SEMICON DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
A10J1001	204-1033-00		CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TKOEM	52011-0410
A10J1002	204-1033-00		CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TKOEM	52011-0410
A10J1003	204-1033-00		CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TKOEM	52011-0410
A10J1005	204-1034-00		CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TKOEM	52011-0610
A10J1006	204-1033-00		CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TKOEM	52011-0410
A10J1007	204-1033-00		CONN BODY,RCPT:1 X 4,WITH SOLDER TAILS	TKOEM	52011-0410
A10J1008	204-1034-00		CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TKOEM	52011-0610
A10J1009	204-1034-00		CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TKOEM	52011-0610
A10J1010	204-1034-00		CONN BODY,RCPT:1 X 6,WITH SOLDER TAILS	TKOEM	52011-0610
A10J7500	131-0955-00		CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
A10L1001	120-1631-00		COIL,RF:FXD,210UH	TK00A	ORDER BY DESCR
A10P2007	131-4460-00		CONN,RCPT,ELEC:HEADER,2 X 6,0.1 CTR	80009	131-4460-00
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	80009	151-0190-00
A10Q1008	151-0190-00		TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
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	80009	151-0190-00
A10Q1012	151-0190-00		TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A10Q1013	151-0190-00		TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A10Q1014	151-0190-00		TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A10Q1101	151-0190-00		TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A10Q1102	151-0188-00		TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
A10Q2501	151-0190-00		TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A10Q2502	151-0190-00		TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
A10Q7503	151-1042-00		SEMICON DVC SE:FET,SI,TO-92	80009	151-1042-00
A10R1001	311-2422-00		RES,VAR,NONW:TRMR,100 OHM	K8788	ORDER BY DESCR
A10R1002	315-0510-00		RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A10R1003	315-0510-00		RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A10R1004	311-2422-00		RES,VAR,NONW:TRMR,100 OHM	K8788	ORDER BY DESCR
A10R1005	321-0097-00		RES,FXD,FILM:100 OHM,1%,0.125W,TC=TO	91637	CMF55116G100ROF
A10R1006	321-0097-00		RES,FXD,FILM:100 OHM,1%,0.125W,TC=TO	91637	CMF55116G100ROF
A10R1007	321-0097-00		RES,FXD,FILM:100 OHM,1%,0.125W,TC=TO	91637	CMF55116G100ROF
A10R1008	321-0097-00		RES,FXD,FILM:100 OHM,1%,0.125W,TC=TO	91637	CMF55116G100ROF
A10R1009	321-0097-00		RES,FXD,FILM:100 OHM,1%,0.125W,TC=TO	91637	CMF55116G100ROF
A10R1010	321-0097-00		RES,FXD,FILM:100 OHM,1%,0.125W,TC=TO	91637	CMF55116G100ROF
A10R1011	321-0097-00		RES,FXD,FILM:100 OHM,1%,0.125W,TC=TO	91637	CMF55116G100ROF
A10R1012	321-0097-00		RES,FXD,FILM:100 OHM,1%,0.125W,TC=TO	91637	CMF55116G100ROF
A10R1013	321-0097-00		RES,FXD,FILM:100 OHM,1%,0.125W,TC=TO	91637	CMF55116G100ROF

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Discnt	Name & Description	Mfr. Code	Mfr. Part No.
A10R1014	321-0097-00		RES,FXD,FILM:100 OHM,1%,0.125W,TC=TO	91637	CMF551166100ROF
A10R1015	321-0170-00		RES,FXD,FILM:576 OHM,1%,0.125W,TC=TO	07716	CEAD576ROF
A10R1016	311-2421-00		RES,VAR,NONMW:TRMR,1K	K8788	ORDER BY DESCR
A10R1017	311-2421-00		RES,VAR,NONMW:TRMR,1K	K8788	ORDER BY DESCR
A10R1018	321-0170-00		RES,FXD,FILM:576 OHM,1%,0.125W,TC=TO	07716	CEAD576ROF
A10R1019	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A10R1020	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A10R1021	321-0261-00		RES,FXD,FILM:5.11K OHM,1%,0.125W,TC=TO	19701	5033ED5K110F
A10R1022	321-0261-00		RES,FXD,FILM:5.11K OHM,1%,0.125W,TC=TO	19701	5033ED5K110F
A10R1023	321-0246-00		RES,FXD,FILM:3.57K OHM,1%,0.125W,TC=TO	19701	5043ED3K570F
A10R1024	321-0246-00		RES,FXD,FILM:3.57K OHM,1%,0.125W,TC=TO	19701	5043ED3K570F
A10R1025	321-0097-00		RES,FXD,FILM:100 OHM,1%,0.125W,TC=TO	91637	CMF551166100ROF
A10R1026	321-0097-00		RES,FXD,FILM:100 OHM,1%,0.125W,TC=TO	91637	CMF551166100ROF
A10R1027	321-0222-00		RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=TO	19701	5033ED2K00F
A10R1028	321-0222-00		RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=TO	19701	5033ED2K00F
A10R1029	315-0512-00		RES,FXD,FILM:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A10R1030	315-0362-00		RES,FXD,FILM:3.6K OHM,5%,0.25W	19701	5043CX3K600J
A10R1031	315-0512-00		RES,FXD,FILM:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A10R1032	315-0512-00		RES,FXD,FILM:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
A10R1033	315-0472-00		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A10R1034	315-0472-00		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A10R1036	311-2420-00		RES,VAR,NONMW:TRMR,10K	K8788	ORDER BY DESCR
A10R1037	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A10R1038	321-0097-00		RES,FXD,FILM:100 OHM,1%,0.125W,TC=TO	91637	CMF551166100ROF
A10R1039	321-0097-00		RES,FXD,FILM:100 OHM,1%,0.125W,TC=TO	91637	CMF551166100ROF
A10R1040	311-2422-00		RES,VAR,NONMW:TRMR,100 OHM	K8788	ORDER BY DESCR
A10R1041	315-0510-00		RES,FXD,FILM:51 OHM,5%,0.25W	19701	5043CX51R00J
A10R1102	321-0289-00		RES,FXD,FILM:10.0K OHM,1%,0.125W,TC=TO	19701	5033ED10K0F
A10R1104	321-0222-00		RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=TO	19701	5033ED2K00F
A10R1105	321-0222-00		RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=TO	19701	5033ED2K00F
A10R1106	321-0222-00		RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=TO	19701	5033ED2K00F
A10R1501	315-0222-00		RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
A10R1504	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R1505	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R1513	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A10R1514	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R1515	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R1516	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R1517	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R1519	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R1751	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R1752	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R1753	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R1754	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R1755	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R1756	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R1757	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R2001	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R2002	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R2003	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R2200	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A10R2250	315-0682-00		RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
A10R2251	315-0682-00		RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
A10R2252	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R2253	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R2254	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R2255	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R2258	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J

Replaceable Electrical Parts - 2210 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Discnt	Name & Description	Mfr. Code	Mfr. Part No.
A10R2259	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R2261	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R2262	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R2501	321-0335-00		RES,FXD,FILM:30.1K OHM,1%,0.125W,TC=TO	57668	RB14FXE30K1
A10R2502	321-0225-00		RES,FXD,FILM:2.15K OHM,1%,0.125W,TC=TO	19701	5033ED2K15F
A10R2503	321-0211-00		RES,FXD,FILM:1.54K OHM,1%,0.125W,TC=TO	07716	CEAD15400F
A10R2505	321-0189-00		RES,FXD,FILM:909 OHM,1%,0.125W,TC=TO	19701	5033ED909R0F
A10R2506	321-0189-00		RES,FXD,FILM:909 OHM,1%,0.125W,TC=TO	19701	5033ED909R0F
A10R2507	321-0149-00		RES,FXD,FILM:348 OHM,1%,0.125W,TC=TO	07716	CEAD348R0F
A10R2508	321-0246-00		RES,FXD,FILM:3.57K OHM,1%,0.125W,TC=TO	19701	5043ED3K570F
A10R2509	311-2420-00		RES,VAR,NONW:TRMR,10K	K8788	ORDER BY DESCR
A10R2510	321-0371-00		RES,FXD,FILM:71.5K OHM,1%,0.125W,TC=TO	07716	CEAD71501F
A10R2511	321-0211-00		RES,FXD,FILM:1.54K OHM,1%,0.125W,TC=TO	07716	CEAD15400F
A10R2513	311-2354-00		RES,VAR,NONW:TRMR,4.7K OHM,0.5W	K8788	TC10-LH2.5-4K7/A
A10R2516	131-0566-00		BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07
A10R3001	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A10R3002	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R3201	315-0134-00		RES,FXD,FILM:130K OHM,5%,0.25W	57668	NTR25J-E130K
A10R7001	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A10R7002	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A10R7003	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A10R7004	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A10R7005	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A10R7006	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A10R7007	315-0104-00		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
A10R7008	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R7009	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A10R7010	315-0470-00		RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A10R7011	315-0470-00		RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A10R7012	315-0470-00		RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A10R7013	315-0470-00		RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A10R7014	315-0470-00		RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A10R7015	315-0470-00		RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A10R7016	315-0470-00		RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A10R7017	315-0103-00		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
A10R7018	315-0102-00		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
A10R7500	315-0470-00		RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
A10R7501	315-0472-00		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
A10R7502	315-0105-00		RES,FXD,FILM:1M OHM,5%,0.25W	19701	5043CX1M000J
A10R7503	315-0151-00		RES,FXD,FILM:150 OHM,5%,0.25W	57668	NTR25J-E150E
A10R8001	315-0134-00		RES,FXD,FILM:130K OHM,5%,0.25W	57668	NTR25J-E130K
A10RP1500	307-1476-00		RES,NTWK,FXD FI:1 K OHM X 8,1%,0.125W	80009	307-1476-00
A10RP1501	307-1476-00		RES,NTWK,FXD FI:1 K OHM X 8,1%,0.125W	80009	307-1476-00
A10RP1502	307-1476-00		RES,NTWK,FXD FI:1 K OHM X 8,1%,0.125W	80009	307-1476-00
A10RP1503	307-1476-00		RES,NTWK,FXD FI:1 K OHM X 8,1%,0.125W	80009	307-1476-00
A10RP2200	307-1477-00		RES,NTWK,FXD FI:10K OHM X 8,1%,0.125W	80009	307-1477-00
A10SW3001	260-2241-00		SWITCH,ROCKER:SPDT,5A,120VAC	09353	7101-J1-Z-B
A10U1101	156-0991-00		MICROCKT,LINEAR:VOLTAGE REGULATOR	04713	MC78L05ACP
A10U1102	156-0158-00		MICROCKT,LINEAR:DUAL OPNL AMPL	04713	MC1458P1/MC1458U
A10U1103	156-2800-00		MICROCKT,INTFC:BIPOLAR,A/D CONV,8 BIT FLSH	80009	156-2800-00
A10U1104	156-2800-00		MICROCKT,INTFC:BIPOLAR,A/D CONV,8 BIT FLSH	80009	156-2800-00
A10U1500	156-1704-01		MICROCKT,DGTL:ASTTL,OCTAL D TYPE F FF	80009	156-1704-01
A10U1501	156-2369-00		MICROCKT,DGTL:OCT BFR/LINE DRVR W/3 ST OUT	04713	MC74HCT541N
A10U1502	156-2256-00		MICROCKT,DGTL:QUADRUPLE 2 INP POS NAND GATE	01295	SN74HC00N3/J4
A10U1503	156-3069-00		MICROCKT,DGTL:HCCMOS,OCTAL D TYPE,FF	80009	156-3069-00
A10U1504	156-2063-00		MICROCKT,DGTL:8D-TYPE FLIP-FLOP	01295	SN74ALS374N3
A10U1505	156-2063-00		MICROCKT,DGTL:8D-TYPE FLIP-FLOP	01295	SN74ALS374N3
A10U1506	156-3492-00		MICROCKT,DGTL:64K BISTATIC RAM,MEMORY	80009	156-3492-00

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Discnt	Name & Description	Mfr. Code	Mfr. Part No.
A10U1507	156-3492-00		MICROCKT,DGTL:64K BISTATIC RAM, MEMORY	80009	156-3492-00
A10U1508	156-2369-00		MICROCKT,DGTL:OCT BFR/LINE DRVR W/3 ST OUT	04713	MC74HCT541N
A10U1509	156-2251-00		MICROCKT,DGTL:FTTL, SYN PRESETTABLE BIN CNTR	04713	MC74F161AN
A10U1510	156-2251-00		MICROCKT,DGTL:FTTL, SYN PRESETTABLE BIN CNTR	04713	MC74F161AN
A10U1511	156-2251-00		MICROCKT,DGTL:FTTL, SYN PRESETTABLE BIN CNTR	04713	MC74F161AN
A10U1512	156-2251-00		MICROCKT,DGTL:FTTL, SYN PRESETTABLE BIN CNTR	04713	MC74F161AN
A10U1513	156-2251-00		MICROCKT,DGTL:FTTL, SYN PRESETTABLE BIN CNTR	04713	MC74F161AN
A10U1514	156-2251-00		MICROCKT,DGTL:FTTL, SYN PRESETTABLE BIN CNTR	04713	MC74F161AN
A10U1515	156-2685-00		MICROCKT,DGTL:HCCMOS, QUAD 2 INP NAND GATE	80009	156-2685-00
A10U1516	156-2357-00		MICROCKT,DGTL:OCTAL LATCH, NONINVERTING	01295	SN74HCT574N3
A10U1517	156-2357-00		MICROCKT,DGTL:OCTAL LATCH, NONINVERTING	01295	SN74HCT574N3
A10U1518	156-2357-00		MICROCKT,DGTL:OCTAL LATCH, NONINVERTING	01295	SN74HCT574N3
A10U1519	156-2357-00		MICROCKT,DGTL:OCTAL LATCH, NONINVERTING	01295	SN74HCT574N3
A10U1520	156-2581-00		MICROCKT,DGTL:LSTTL, DUAL 4 CHAN MULTIPLEXER	80009	156-2581-00
A10U1521	156-1723-00		MICROCKT,DGTL:QUAD 2 INPUT & GATE	04713	MC74F08 ND OR JD
A10U1522	156-1973-00		MICROCKT,DGTL:STTL, QUAD D FF	07263	74F175PCQR
A10U1524	156-1707-00		MICROCKT,DGTL:QUAD 2-INPUT NAND GATE, SCRN	04713	MC7400(NDORJD)
A10U1750	156-3491-00		MICROCKT,DGTL:QUAD, 2 INPUT & GATE	80009	156-3491-00
A10U1751	156-1611-00		MICROCKT,DGTL:ASTTL, DUAL D TYPE EDGE-TRIG	80009	156-1611-00
A10U1752	156-2009-00		MICROCKT,DGTL:FLIP-FLOP, DUAL D	04713	MC74HC74N
A10U1753	160-5368-00		MICROCKT,DGTL:LOGIC ARRAY, PRGM	80009	160-5368-00
A10U1754	160-5378-00		MICROCKT,DGTL:LOGIC ARRAY, PRGM	80009	160-5378-00
A10U1755	156-1751-00		MICROCKT,DGTL:FTTL, 4-2-3-2 INP AND/OR	04713	MC74F64NDS
A10U1756	156-1751-00		MICROCKT,DGTL:FTTL, 4-2-3-2 INP AND/OR	04713	MC74F64NDS
A10U1757	156-1611-00		MICROCKT,DGTL:ASTTL, DUAL D TYPE EDGE-TRIG	80009	156-1611-00
A10U1758	156-1611-00		MICROCKT,DGTL:ASTTL, DUAL D TYPE EDGE-TRIG	80009	156-1611-00
A10U1760	156-1611-00		MICROCKT,DGTL:ASTTL, DUAL D TYPE EDGE-TRIG	80009	156-1611-00
A10U1761	160-5379-00		MICROCKT,DGTL:LOGIC ARRAY, PRGM	80009	160-5379-00
A10U1762	160-5380-00		MICROCKT,DGTL:LOGIC ARRAY, PRGM	80009	160-5380-00
A10U1763	160-5381-00		MICROCKT,DGTL:LOGIC ARRAY, PRGM	80009	160-5381-00
A10U1764	156-3491-00		MICROCKT,DGTL:QUAD, 2 INPUT & GATE	80009	156-3491-00
A10U1765	156-2463-00		MICROCKT,DGTL:HCCMOS, QUAD 2-INP OR GATE	04713	MC74HC32ND
A10U1766	156-2026-00		MICROCKT,DGTL:CMOS, QUAD 2 INPUT NOR GATE	04713	MC74HC02(N OR J)
A10U1767	156-1611-00		MICROCKT,DGTL:ASTTL, DUAL D TYPE EDGE-TRIG	80009	156-1611-00
A10U2001	160-5367-00		MICROCKT,DGTL:LOGIC ARRAY, PRGM	80009	160-5367-00
A10U2002	156-3069-00		MICROCKT,DGTL:HCCMOS, OCTAL D TYPE, FF	80009	156-3069-00
A10U2003	156-3069-00		MICROCKT,DGTL:HCCMOS, OCTAL D TYPE, FF	80009	156-3069-00
A10U2004	156-2027-00		MICROCKT,DGTL:CMOS, HEX INVERTER	27014	MM74HC04N
A10U2005	156-3490-00		MICROCKT,DGTL:64 BIT STATIC RAM, MEM	80009	156-3490-00
A10U2006	156-3490-00		MICROCKT,DGTL:64 BIT STATIC RAM, MEM	80009	156-3490-00
A10U2007	156-1664-00		MICROCKT,DGTL:SCREENED	01295	SN74ALS574(NP3)
A10U2008	156-1973-00		MICROCKT,DGTL:STTL, QUAD D FF	07263	74F175PCQR
A10U2251	156-2256-00		MICROCKT,DGTL:QUADRUPLE 2 INP POS NAND GATE	01295	SN74HC00N3/J4
A10U2253	156-2026-00		MICROCKT,DGTL:CMOS, QUAD 2 INPUT NOR GATE	04713	MC74HC02(N OR J)
A10U2254	156-2009-00		MICROCKT,DGTL:FLIP-FLOP, DUAL D	04713	MC74HC74N
A10U2255	156-2463-00		MICROCKT,DGTL:HCCMOS, QUAD 2-INP OR GATE	04713	MC74HC32ND
A10U2256	156-3063-00		MICROCKT,DGTL:HCCMOS, DUAL 1 TO 4 LINE DCDR	80009	156-3063-00
A10U2257	156-2761-00		MICROCKT,DGTL:CMOS, SU-GATE	04713	74HC138
A10U2258	156-2009-00		MICROCKT,DGTL:FLIP-FLOP, DUAL D	04713	MC74HC74N
A10U2259	160-5382-00		MICROCKT,DGTL:LOGIC ARRAY, PRGM	80009	160-5382-00
A10U2261	160-5383-00		MICROCKT,DGTL:LOGIC ARRAY, PRGM	80009	160-5383-00
A10U2262	160-5384-00		MICROCKT,DGTL:LOGIC ARRAY, PRGM	80009	160-5384-00
A10U2501	156-1255-00		MICROCKT, LINEAR: D/A CONVERTER, 8 BIT	06665	DAC08-157Q
A10U2502	156-3517-00		MICROCKT,DGTL:H SLEW RATE, JFET INPUT, OP AMP	TKOEN	34082P
A10U3001	156-2027-00		MICROCKT,DGTL:CMOS, HEX INVERTER	27014	MM74HC04N
A10U3002	156-2027-00		MICROCKT,DGTL:CMOS, HEX INVERTER	27014	MM74HC04N
A10U3005	156-2009-00		MICROCKT,DGTL:FLIP-FLOP, DUAL D	04713	MC74HC74N
A10U3006	156-1756-00		MICROCKT,DGTL:ALSTTL, DUAL D TYPE FF, W/CL	01295	SN74ALS74NP3/JP4

Replaceable Electrical Parts - 2210 Service

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A10U3203	156-3493-00		MICROCKT,DGTL:HEX INVERTER	80009	156-3493-00
A10U3204	156-2026-00		MICROCKT,DGTL:CMOS,QUAD 2 INPUT NOR GATE	04713	MC74HC02(N OR J)
A10U7001	119-1460-00		OSCILLATOR,RF:40.0MHZ	01537	K1100AM 40 MHz
A10U7002	156-1722-00		MICROCKT,DGTL:FTTL,HEX INVERTER	04713	MC74F04ND
A10U7003	156-1919-00		MICROCKT,DGTL:FTTL,DUAL POS EDGE TRIG FF	04713	MC74F109 ND/JD
A10U7004	156-1743-00		MICROCKT,DGTL:FTTL,QUAD 2-INPUT NOR GATE	18324	74F02 NB OR FB
A10U7005	156-1919-00		MICROCKT,DGTL:FTTL,DUAL POS EDGE TRIG FF	04713	MC74F109 ND/JD
A10U7006	156-1973-00		MICROCKT,DGTL:STTL,QUAD D FF	07263	74F175PCQR
A10U7007	156-1662-00		MICROCKT,DGTL:ASTTL,DUAL 4 INP MUX	04713	MC74F153 ND/JD
A10U7008	156-1611-00		MICROCKT,DGTL:ASTTL,DUAL D TYPE EDGE-TRIG	80009	156-1611-00
A10U7009	156-2092-00		MICROCKT,DGTL:QUAD 2-INP POS NOR GATES	01295	SN74ALS02N3
A10U7010	156-2333-00		MICROCKT,DGTL:ALSTTL,SYNC,4 BIT DECADE CNTR	01295	SN74ALS162BN3
A10U7011	156-2333-00		MICROCKT,DGTL:ALSTTL,SYNC,4 BIT DECADE CNTR	01295	SN74ALS162BN3
A10U7012	156-2333-00		MICROCKT,DGTL:ALSTTL,SYNC,4 BIT DECADE CNTR	01295	SN74ALS162BN3
A10U7013	156-2333-00		MICROCKT,DGTL:ALSTTL,SYNC,4 BIT DECADE CNTR	01295	SN74ALS162BN3
A10U7014	156-2333-00		MICROCKT,DGTL:ALSTTL,SYNC,4 BIT DECADE CNTR	01295	SN74ALS162BN3
A10U7015	156-2333-00		MICROCKT,DGTL:ALSTTL,SYNC,4 BIT DECADE CNTR	01295	SN74ALS162BN3
A10U7016	156-2176-00		MICROCKT,DGTL:TTL,TRIPLE 3-IN POS AND GATE	01295	SN74ALS11AN3
A10U7017	156-1611-00		MICROCKT,DGTL:ASTTL,DUAL D TYPE EDGE-TRIG	80009	156-1611-00
A10U7018	156-3491-00		MICROCKT,DGTL:QUAD,2 INPUT & GATE	80009	156-3491-00
A10U7066	156-2026-00		MICROCKT,DGTL:CMOS,QUAD 2 INPUT NOR GATE	04713	MC74HC02(N OR J)
A10U8003	156-2256-00		MICROCKT,DGTL:QUADRUPL 2 INP POS NAND GATE	01295	SN74HC00N3/J4
A10W2500	131-0566-00		BUS,CONDUCTOR:DUMMY RES,0.094 OD X 0.225 L	24546	OMA 07

Component No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Name & Description	Mfr. Code	Mfr. Part No.
J100	131-0955-00		CONN, RCPT, ELEC: BNC, FEMALE	13511	31-279
J151	131-0955-00		CONN, RCPT, ELEC: BNC, FEMALE	13511	31-279
J300	131-0955-00		CONN, RCPT, ELEC: BNC, FEMALE	13511	31-279
J590	131-3898-00		TERM, FEEDTHRU: 0.658 M X 0.75 DIA, BRS, AU PL	K0491	001-1401-041140P
T901	120-1798-00		TRANSFORMER, RF: TORIODAL, MAINS	K5545	ORDER BY DESCR
V900	154-0907-00		ELECTRON TUBE: CRT, FINISHED	80009	154-0907-00

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/IEEE 91-1984. 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 LO 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

Y14.2M-1979

ANSI/IEEE 280-1985

Drafting Practices.

Line Conventions and Lettering.

Letter Symbols for Quantities
Used in Electrical Science
and Electrical Engineering.

American National Standards Institute
1430 Broadway
New York, New York 10018

Component Values

Electrical components shown on the diagrams are in the following units unless noted otherwise:

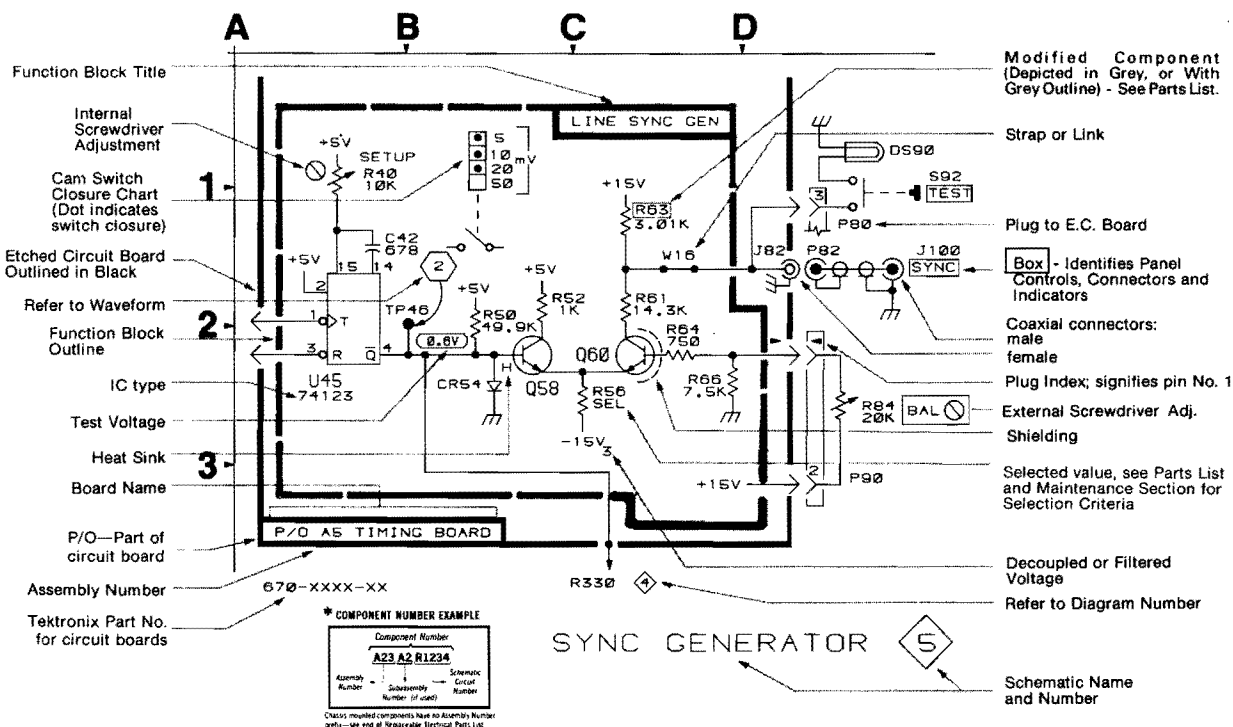
Capacitors Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μ F).
Resistors Ohms (Ω).

———— 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.



- 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).



- 1. Determine the Circuit Board Illustration and Component Location.**



- 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.
- 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.
- Look in the BOARD LOCATION column next to the component number and read its circuit board grid coordinates.

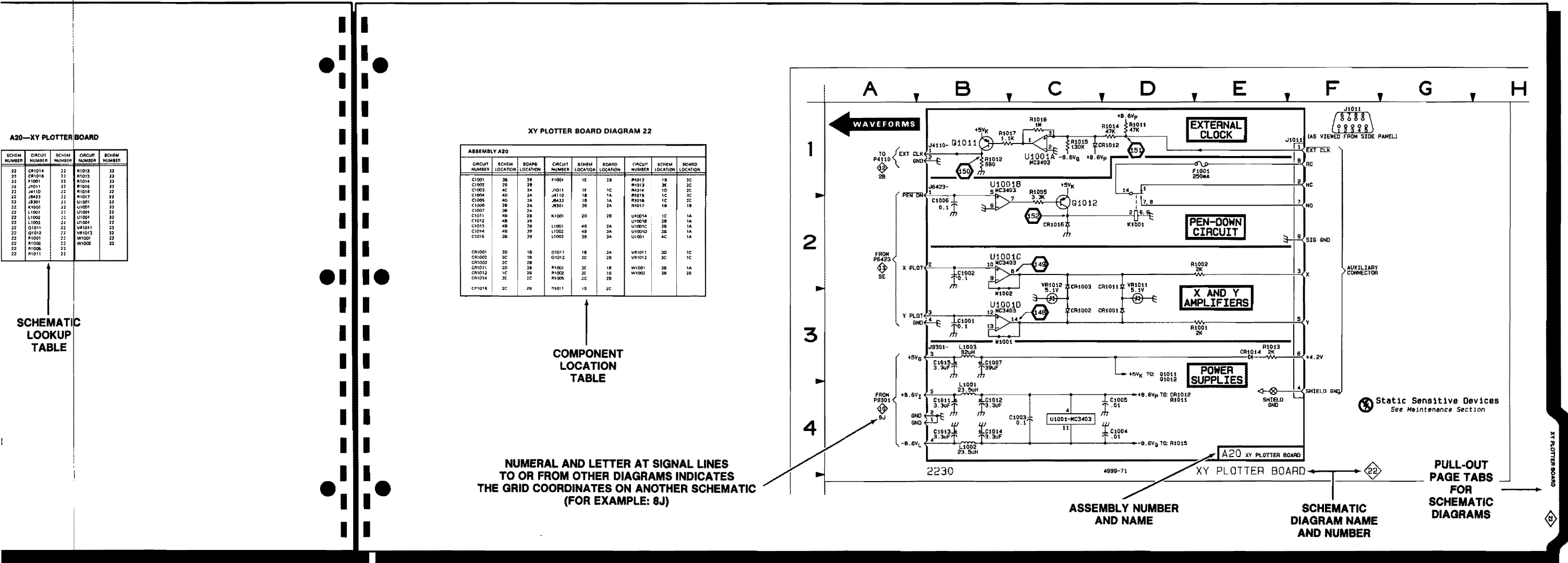


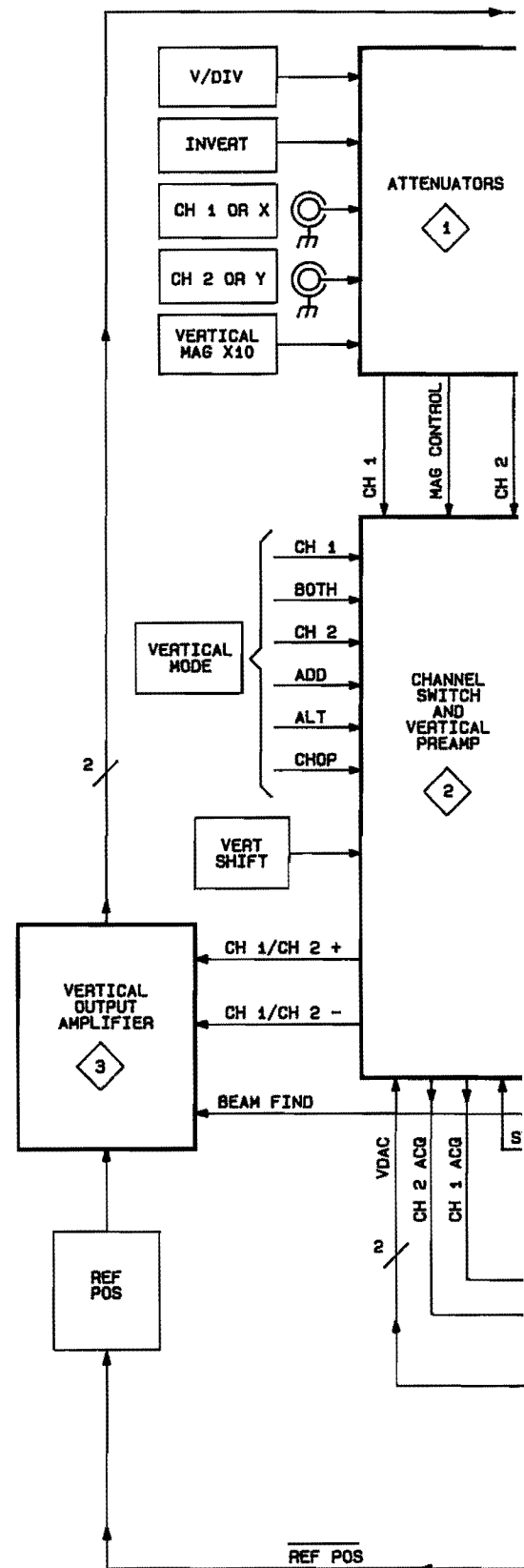
2. Determine the Circuit Number and Schematic Diagram.

- 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.





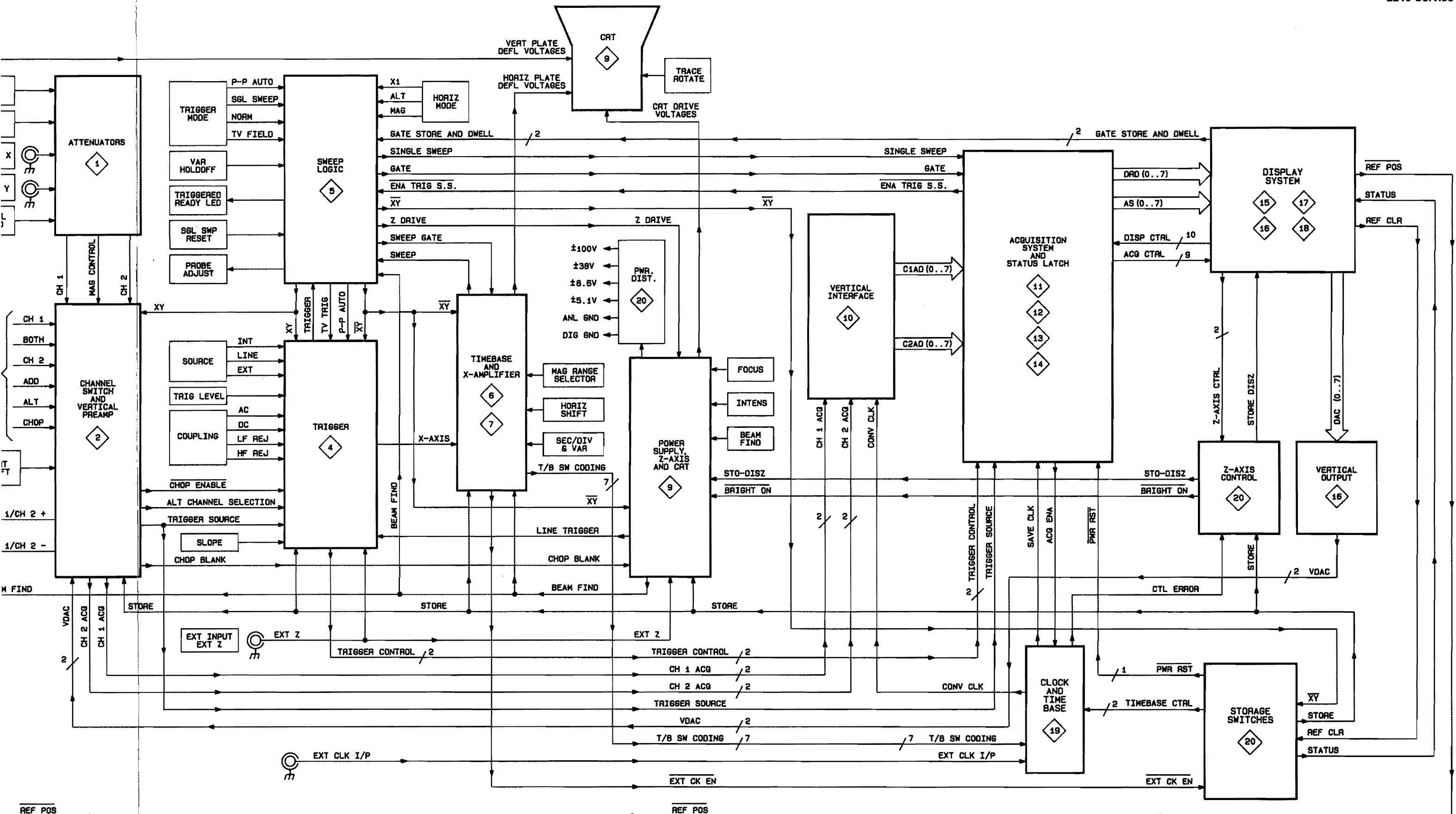
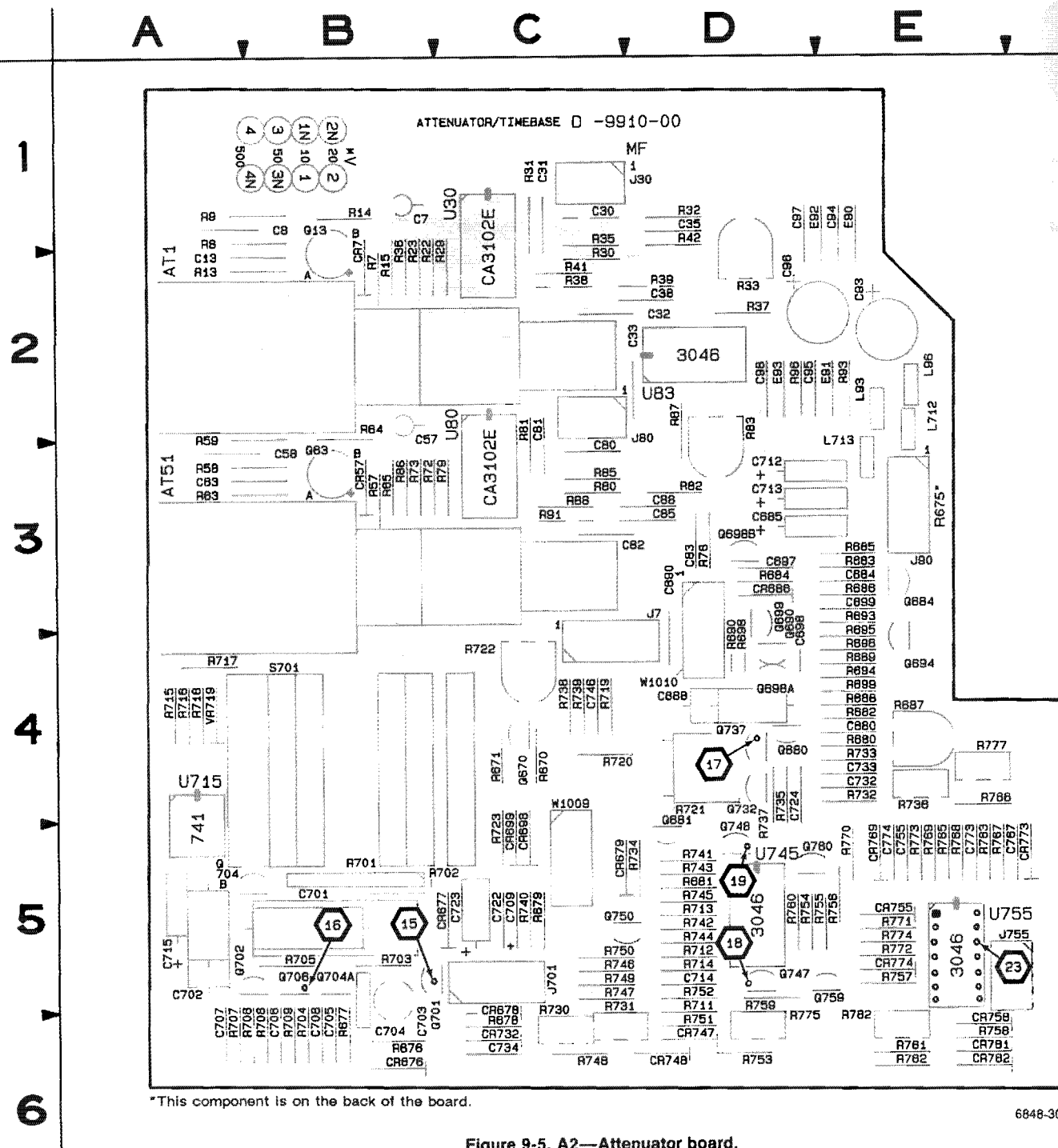


Figure 9-4. 2210 Simplified block diagram.

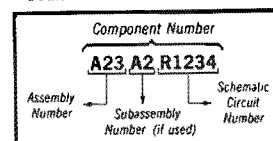
A2—ATTENUATOR BOARD, FIG. 9-5
CHASSIS PARTS

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Figure 9-5. A2—Attenuator board.

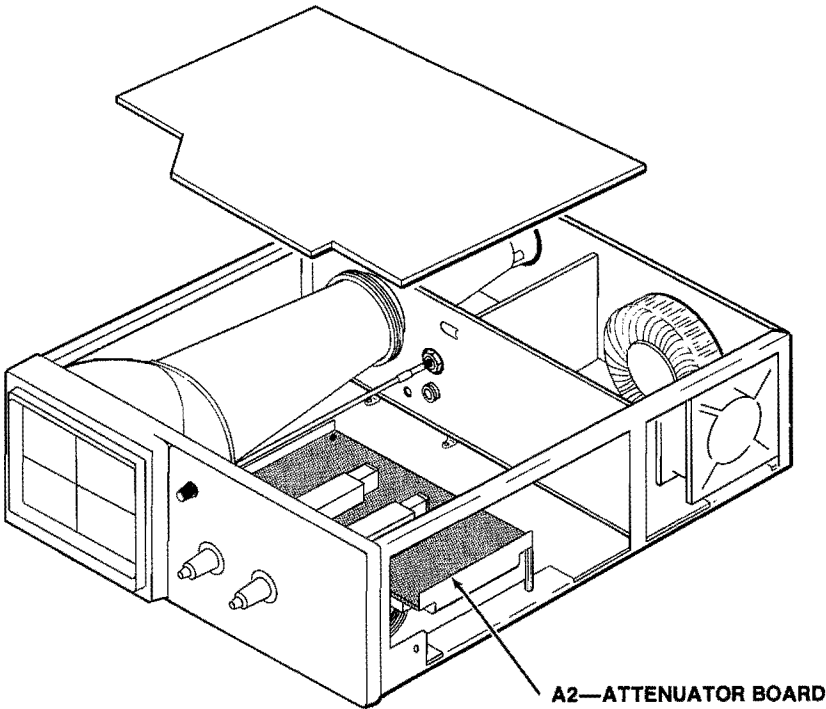
⚡ Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

A2—ATTENUATOR/TIME BASE 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	C714	7	J755	7	R36	1	R689	6	R745	7
AT51	1	C715	6			R37	1	R690	6	R746	7
		C722	6	L93	1	R38	1	R693	6	R747	7
C6	1	C723	6	L96	1	R39	1	R694	6	R748	7
C8	1	C724	6	L712	6	R41	1	R695	6	R749	7
C13	1	C732	6	L713	6	R42	1	R696	6	R750	7
C30	1	C733	6			R53	1	R698	6	R751	7
C31	1	C734	6	Q13	1	R55	1	R699	6	R752	7
C32	1	C746	7	Q63	1	R56	1	R700	6	R753	7
C33	1	C755	7	Q670	6	R57	1	R701	6	R754	7
C35	1	C767	7	Q680	6	R58	1	R702	6	R755	7
C38	1	C773	7	Q681	6	R59	1	R703	6	R756	7
C56	1	C774	7	Q684	6	R63	1	R704	6	R757	7
C58	1			Q690	6	R64	1	R705	6	R758	7
C63	1	CR7	1	Q694	6	R65	1	R706	6	R759	7
C80	1	CR57	1	Q698	6	R72	1	R707	6	R760	7
C81	1	CR676	6	Q699	6	R73	1	R708	6	R761	7
C82	1	CR677	6	Q701	6	R78	1	R709	6	R762	7
C83	1	CR678	6	Q702	6	R79	1	R711	7	R763	7
C85	1	CR679	6	Q704	6	R80	1	R712	7	R765	7
C88	1	CR686	6	Q706	6	R81	1	R713	7	R766	7
C93	1	CR698	6	Q732	6	R82	1	R714	7	R767	7
C94	1	CR699	6	Q737	6	R83	1	R715	6	R768	7
C95	1	CR732	6	Q747	7	R85	1	R716	6	R769	7
C96	1	CR747	7	Q748	7	R86	1	R717	6	R770	7
C97	1	CR748	7	Q750	7	R87	1	R718	6	R771	7
C98	1	CR755	7	Q759	7	R88	1	R719	6	R772	7
C680	6	CR758	7	Q760	7	R91	1	R720	6	R773	7
C884	6	CR761	7			R93	1	R721	6	R774	7
C885	6	CR762	7	R3	1	R96	1	R722	6	R775	7
C886	6	CR769	7	R5	1	R670	6	R723	6	R777	7
C690	6	CR773	7	R6	1	R671	6	R730	7	R782	7
C697	6	CR774	7	R7	1	R675	6	R731	7		
C698	6			R8	1	R676	6	R732	6	S701	6
C699	6	E90	1	R9	1	R677	6	R733	6		
C701	6	E91	1	R13	1	R678	6	R734	6	U30	1
C702	6	E92	1	R14	1	R679	6	R735	6	U80	1
C703	6	E93	1	R15	1	R680	6	R736	6	U83	1
C704	6			R22	1	R681	6	R737	6	U715	6
C705	6	J7	7	R23	1	R682	6	R738	7	U745	7
C706	6	J29	1	R29	1	R683	6	R739	7	U755	7
C707	6	J30	1	R30	1	R684	6	R740	6		
C708	6	J79	1	R31	1	R685	6	R741	7	VR719	6
C709	6	J80	1	R32	1	R686	6	R742	7		
C712	6	J90	6	R33	1	R687	6	R743	7	W1009	6
C713	6	J701	6	R35	1	R688	6	R744	7	W1010	6



OTHER PARTS							
CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
B1	9	J151	1	P900	9		
DL224	3	J300	8	R7500	10	V900	9
J100	1	J590	5				
		J7500	10	T901	9		

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 setting required for the 2210 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 2210 Control Settings

Vertical (Both Channels)

POSITION	Midrange
MODE	CH1, NORM
VOLTS/DIV	10 mV
VOLTS/DIV Var	In CAL detent
Magnification	X1 (CAL knob in)
Input Coupling	GND

Horizontal

POSITION (both)	Midrange
MAG	X1

SEC/DIV	0.5 ms
SEC/DIV Var	In CAL detent

Trigger

SOURCE	VERT MODE
COUPLING	DC
MODE	P-P AUTO
SLOPE	Positive
HOLDOFF	MIN

Storage Controls

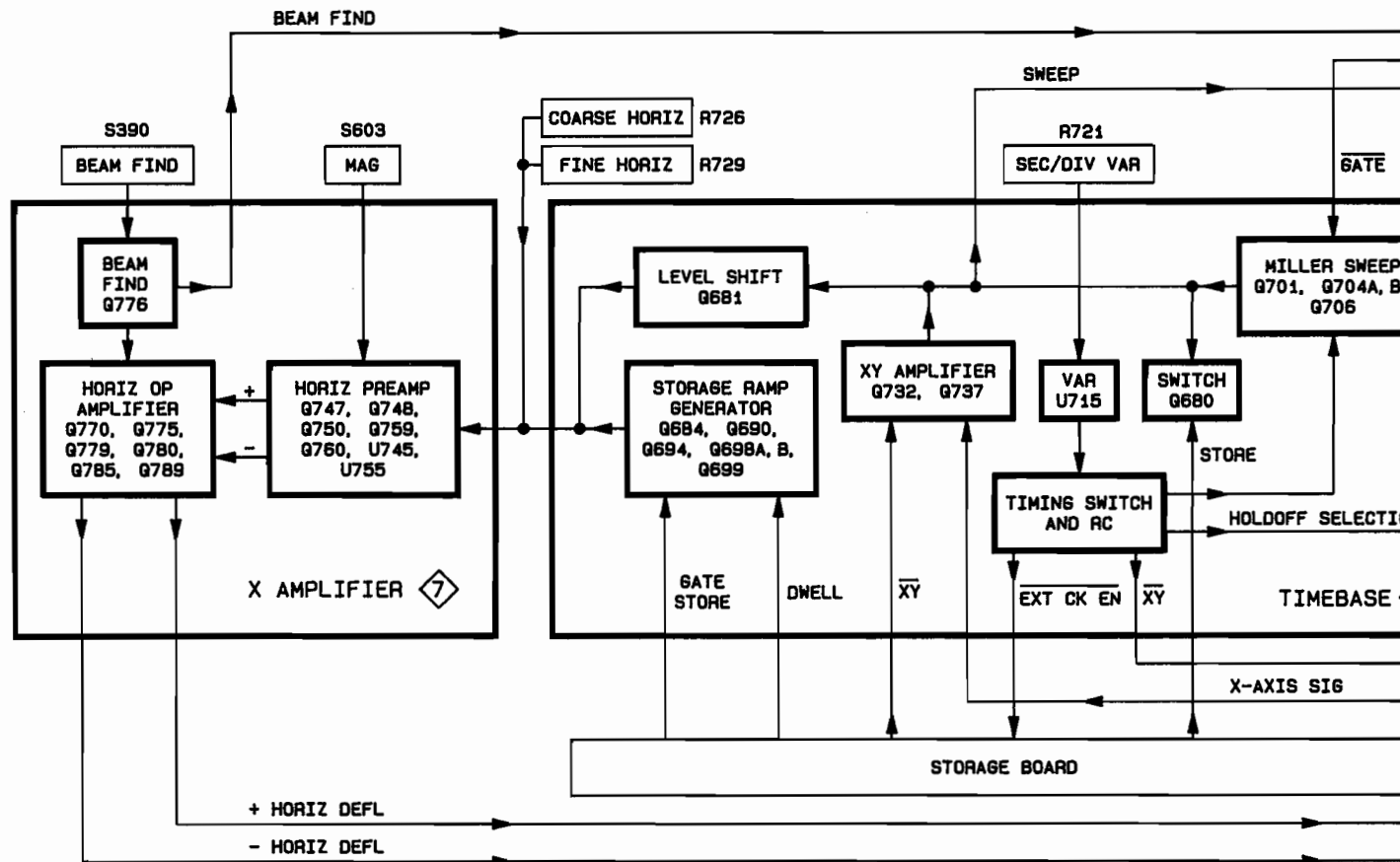
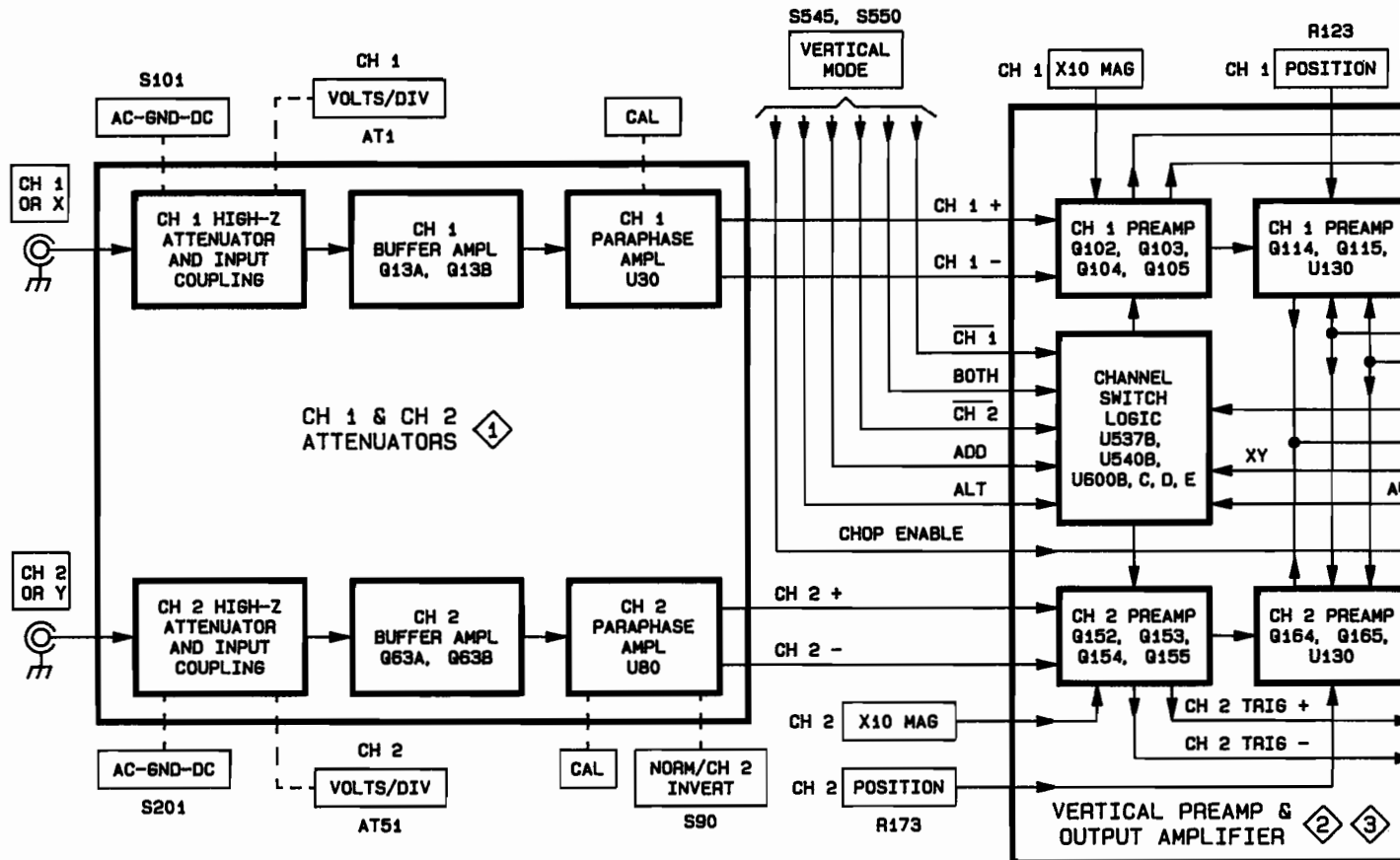
ACQ	CONTINUE
PRE-TRIG	25%
STORE/NON-STORE	NON-STORE

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 menu meets the required specifications for testing this instrument.



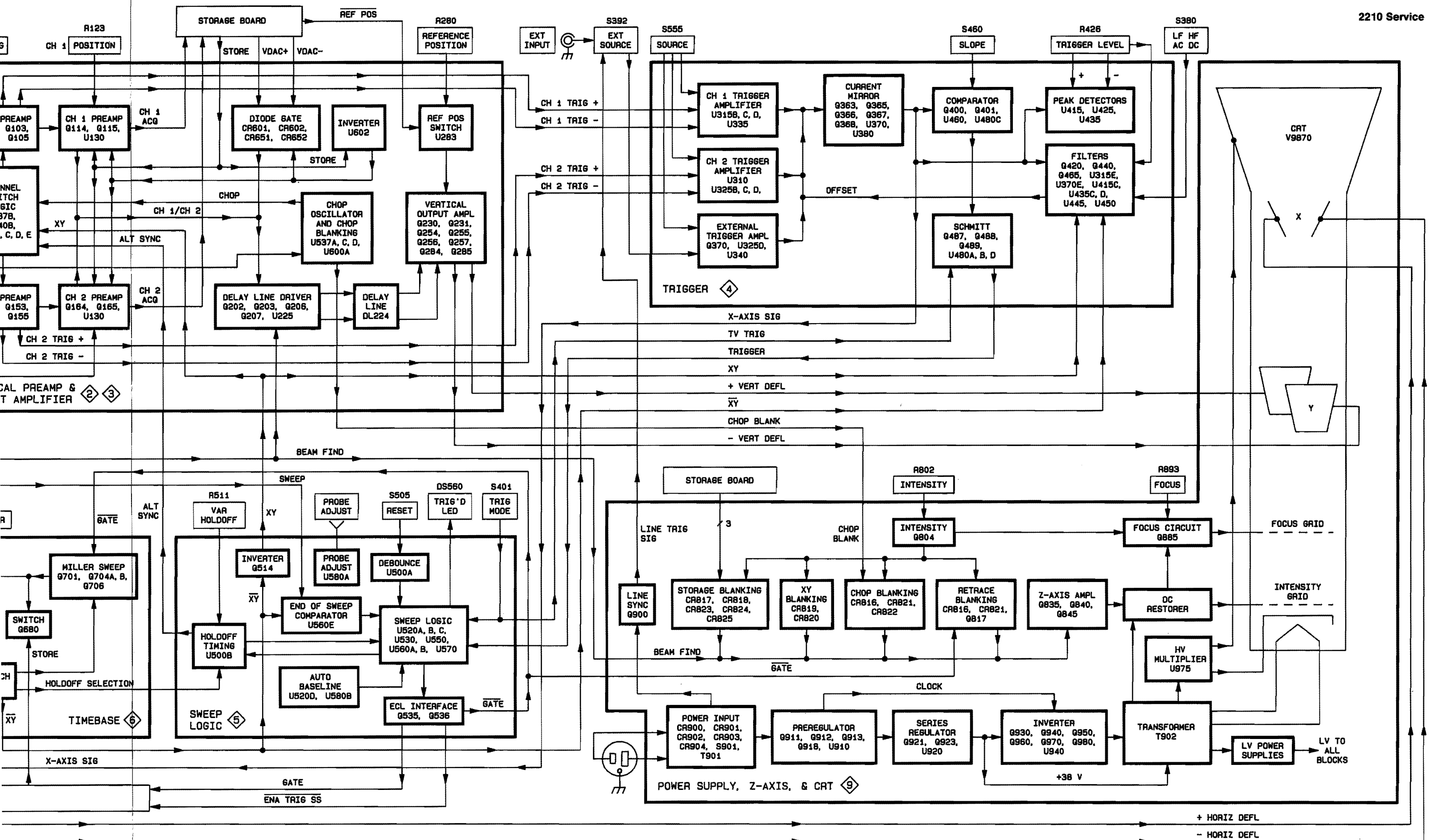


Figure 9-6. 2210 Detailed block diagram.

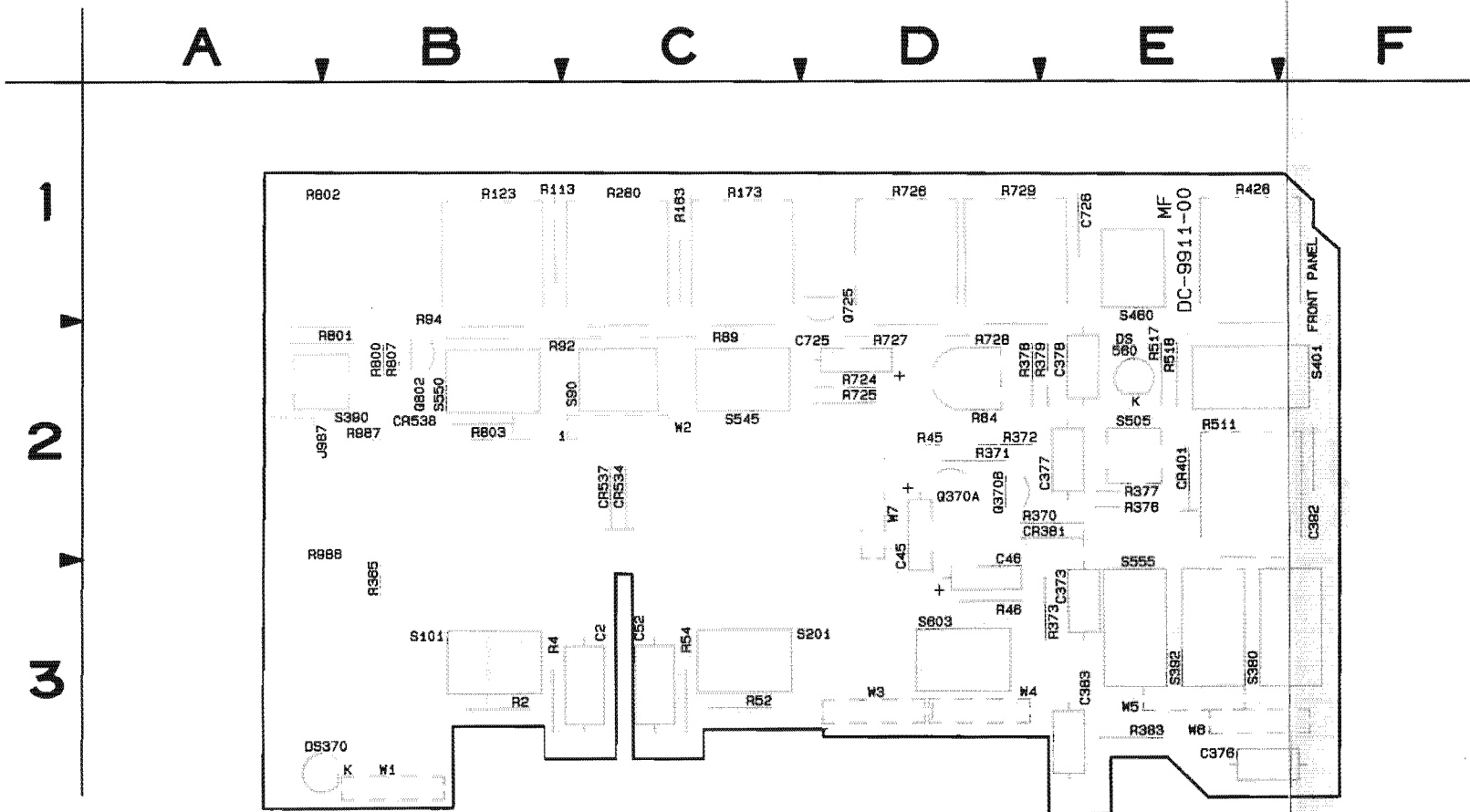


Figure 9-7. A3—Front Panel board.

A3—FRONT PANEL BOARD							
CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
C2	1	Q725	8	R373	8	S90	1
C45	8	Q802	8	R376	8	S101	1
C46	8			R377	8	S201	1
C52	1	R1	1	R378	8	S380	8
C373	8	R2	1	R379	8	S392	8
C376	8	R4	1	R382	8	S401	8
C377	8	R45	8	R383	8	S460	8
C378	8	R46	8	R426	8	S505	5
C383	8	R51	1	R511	5	S545	2
C392	8	R52	1	R517	5	S555	2
C402	8	R54	1	R518	5	S603	8
C403	8	R84	1	R724	8		
C725	8	R89	1	R725	8		
C726	8	R92	1	R726	8		
		R94	1	R727	8		
CR381	8	R113	2	R728	8	W1	8
CR534	2	R123	2	R729	8	W2	8
CR537	2	R163	2	R800	9	W3	8
CR538	2	R173	2	R801	9	W4	8
		R280	3	R802	9	W5	8
DS370	8	R365	8	R803	8	W6	8
DS560	5	R370	8	R807	8	W7	8
Q370	8	R371	8	R986	9		
		R372	8	R987	9		

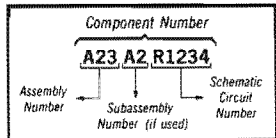
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FIG 9-7

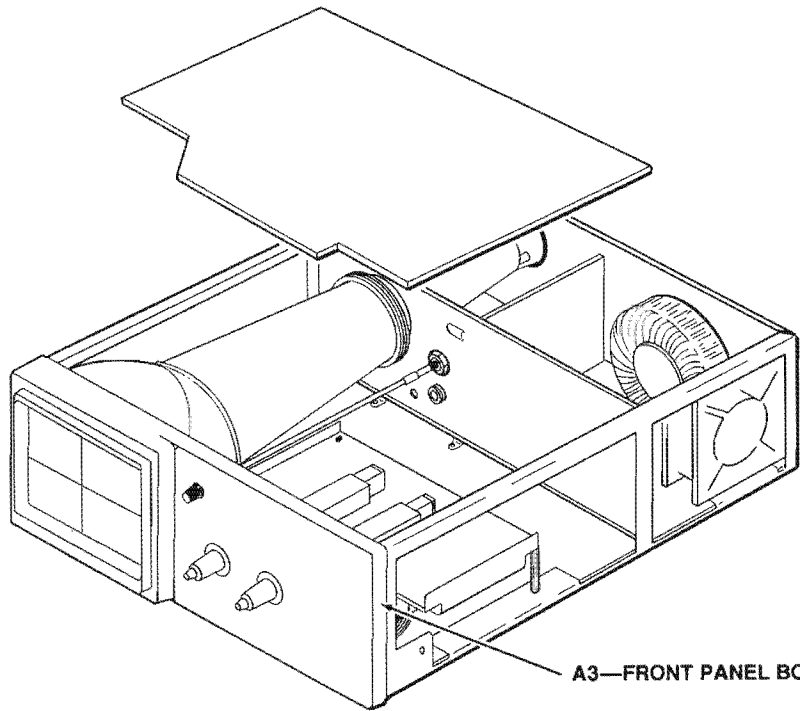
A3—FRONT PANEL BOARD

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



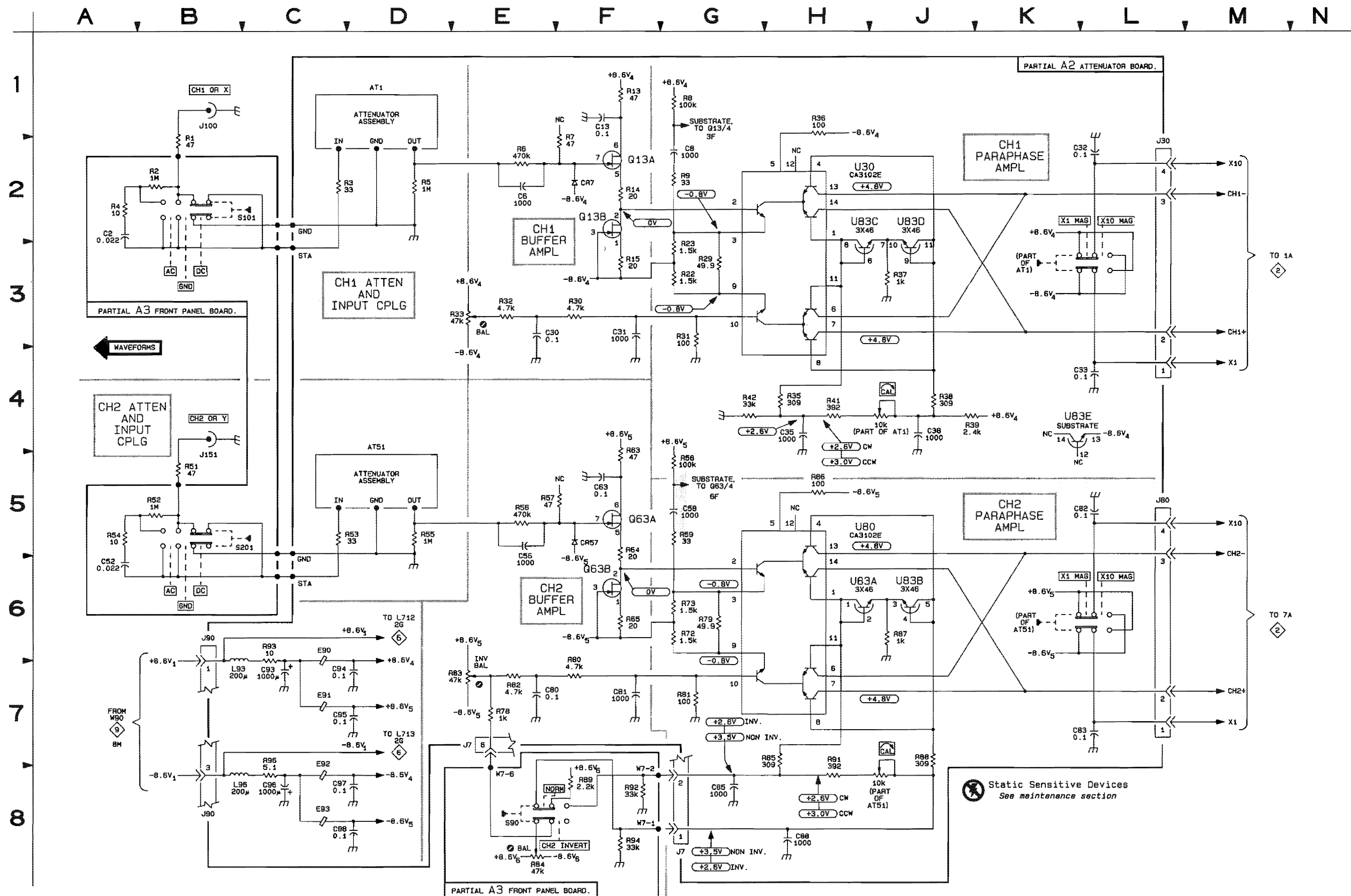
Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.



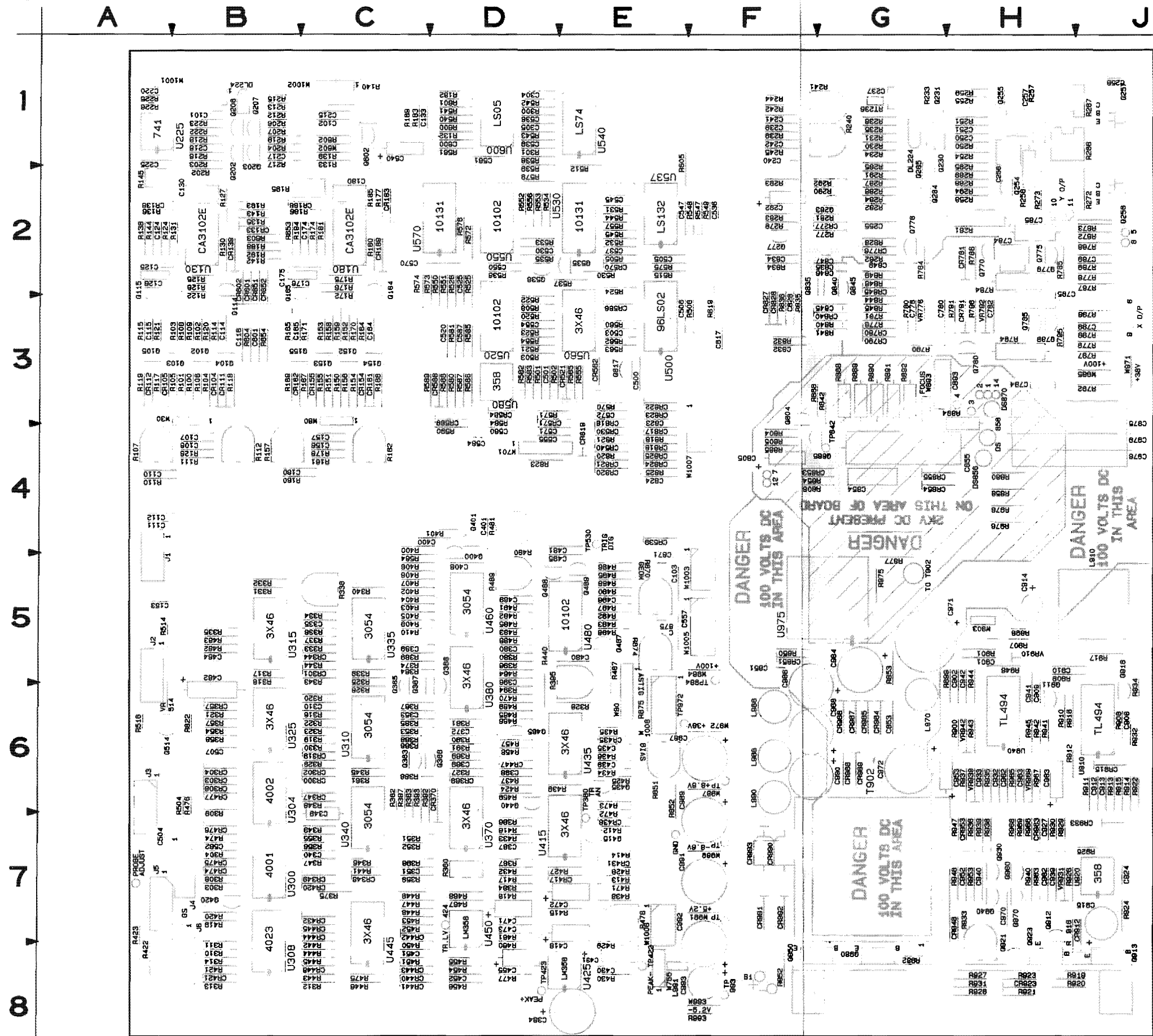
A3—FRONT PANEL BOARD

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
AT1	1D	2A	C97	8D	1D	R7	2F	2B	R58	5G	3A
AT51	5D	3A	C98	8D	2D	R8	1G	1A	R59	5G	2B
						R9	2G	1A	R63	5F	3A
C8	2E	2B	CR7	2F	2B	R13	1F	2A	R64	5F	3B
C8	2G	1B	CR57	5F	3B	R14	2F	1B	R65	6F	3B
C13	1F	2A				R15	3F	2B	R72	6G	3B
C30	3E	1C	E90	6C	1E	R22	3G	2B	R73	6G	3B
C31	3F	1C	E91	7C	2E	R23	3G	2B	R78	7E	3D
C32	2L	2D	E92	8C	1E	R29	3G	2C	R79	6G	3C
C33	4L	2C	E93	8C	2D	R30	3F	2C	R80	7F	3C
C35	4H	1D				R31	3G	1C	R81	7G	2C
C38	4J	2D	J29	2G	1C	R32	3E	1D	R82	7E	3D
C56	5E	3B	J30	2L	1C	R33	3E	2E	R83	7E	2D
C58	5G	3B	J79	5G	3C	R35	4H	1C	R85	7H	3C
C63	5F	3A	J80	5L	2C	R36	1H	2B	R86	5H	3B
C80	7E	3C				R37	3J	2E	R87	8J	2D
C81	7F	2C	L93	6B	2E	R38	4J	2C	R88	7J	3C
C82	5L	3C	L96	8B	2E	R39	4J	2D	R91	7H	3C
C83	7L	3D				R41	4H	2C	R93	6C	2E
C85	8G	3D	Q13	2F	2B	R42	4G	2D	R96	8C	2D
C88	8H	3D	Q63	5F	3B	R53	5C	4A			
C93	7C	2E				R55	5D	4B	U30	2H	1C
C94	7D	2E	R3	2C	2A	R56	5E	3B	U80	5H	2C
C95	7D	2D	R5	2D	2B	R57	5F	3B	U83	6J	2D
C96	8C	2E	R6	2E	2B						
Partial A2 also shown on diagrams 6 and 7.											
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	2A	3C	R4	2A	3B	R84	8E	2D	S90	8E	2C
C52	6A	3C	R51	5B	3D	R89	8F	2C	S101	2B	3B
			R52	5B	3C	R92	8F	2C	S201	5B	3C
R1	2B	3B	R54	5A	3C	R94	8F	2B			
R2	2B	3B									
Partial A3 also shown on diagrams 2, 3, 5, 8 and 9.											
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
J100	1B	CHASSIS	J151	4B	CHASSIS						

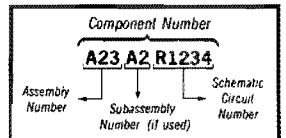


**A1—MAIN BOARD
COMPONENT VIEW**



 **Static Sensitive Devices**
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

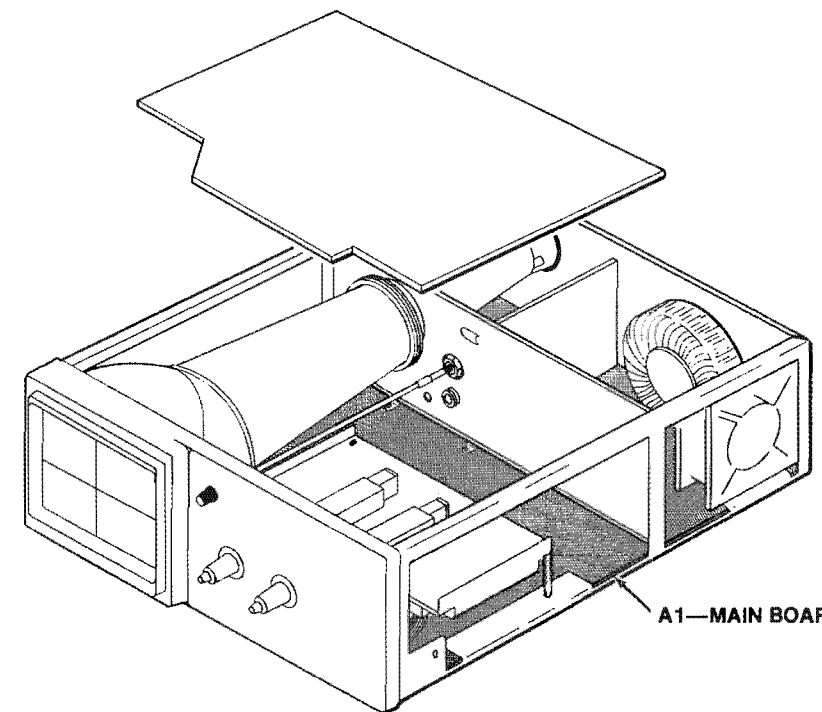


Figure 9-8. A1—Main board component view.

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
R245	3	R356	4	R450	4	R553	5	R844	9	R978	9
R250	3	R357	4	R451	4	R554	5	R845	9	R982	9
R251	3	R358	4	R452	4	R555	5	R846	9	R983	9
R254	3	R359	4	R453	4	R556	5	R849	9	R993	9
R255	3	R360	4	R454	4	R557	5	R850	9		
R256	3	R361	4	R455	4	R560	5	R851	9	RT236	3
R257	3	R362	4	R456	4	R561	2	R852	9		
R258	3	R363	4	R457	4	R562	5	R853	9	T902	9
R259	3	R364	4	R458	4	R563	5	R854	9		
R261	3	R366	4	R459	4	R564	5	R858	9	U130	2
R262	7	R367	4	R460	4	R565	5	R860	9	U180	2
R266	3	R368	4	R461	4	R570	5	R870	9	U225	3
R267	3	R369	4	R462	4	R571	5	R872	9	U300	4
R272	3	R374	4	R468	4	R572	5	R873	9	U304	4
R273	3	R375	4	R470	4	R573	5	R874	9	U308	4
R277	3	R380	4	R472	4	R574	5	R875	9	U310	4
R279	3	R381	4	R473	4	R575	5	R877	9	U315	4
R281	3	R384	4	R474	4	R576	5	R885	9	U325	4
R282	3	R385	4	R475	4	R577	5	R886	9	U335	4
R283	3	R386	4	R476	4	R579	5	R888	9	U340	4
R284	3	R387	4	R477	4	R580	5	R889	9	U370	4
R285	3	R388	4	R478	4	R581	5	R890	9	U380	4
R286	3	R389	4	R480	4	R582	5	R891	9	U415	4
R287	3	R390	4	R481	4	R583	5	R892	9	U425	4
R288	3	R391	4	R482	4	R584	5	R894	9	U435	4
R289	3	R392	4	R483	4	R585	5	R898	9	U445	4
R290	3	R393	4	R485	4	R586	5	R899	9	U450	4
R291	3	R394	4	R486	4	R587	5	R900	9	U460	4
R292	3	R395	4	R487	4	R588	5	R901	9	U480	4
R293	3	R396	4	R488	4	R589	5	R907	9	U500	5
R294	3	R397	4	R489	4	R590	5	R908	9	U520	5
R295	3	R398	4	R490	4	R600	2	R909	9	U530	5
R300	4	R400	4	R491	4	R601	2	R910	9	U537	2
R301	4	R401	4	R492	4	R602	2	R911	9	U540	2
R303	4	R402	4	R493	4	R603	2	R912	9	U550	5
R304	4	R403	4	R495	4	R604	2	R913	9	U560	5
R308	4	R404	4	R496	4	R605	2	R914	9	U570	5
R309	4	R405	4	R497	4	R653	2	R915	9	U580	5
R310	4	R406	4	R498	4	R654	2	R916	9	U600	2
R311	4	R407	4	R501	5	R764	7	R917	9	U910	9
R312	4	R408	4	R502	5	R776	7	R918	9	U920	9
R313	4	R409	4	R503	5	R778	7	R919	9	U940	9
R314	4	R410	4	R504	5	R779	7	R920	9	U975	9
R316	4	R412	4	R505	5	R780	7	R921	9		
R317	4	R413	4	R506	5	R781	7	R922	9	VR514	5
R318	4	R414	4	R508	5	R784	7	R923	9	VR776	7
R319	4	R415	4	R512	5	R785	7	R924	9	VR792	7
R320	4	R416	4	R514	5	R786	7	R925	9	VR910	9
R321	4	R417	4	R515	5	R787	7	R926	9	VR931	9
R322	4	R418	4	R516	5	R788	7	R927	9	VR939	9
R323	4	R419	4	R520	5	R789	7	R928	9	VR942	9
R325	4	R420	4	R521	5	R790	7	R929	9	VR969	9
R326	4	R421	4	R522	5	R791	7	R930	9		
R327	4	R422	4	R523	5	R792	7	R931	9	W30	2
R328	4	R423	4	R524	5	R794	7	R932	9	W80	2
R329	4	R424	4	R525	5	R795	7	R933	9	W90	9
R330	4	R425	4	R526	5	R796	7	R934	9	W590	5
R331	4	R427	4	R530	5	R797	7	R935	9	W602	2
R332	4	R428	4	R531	5	R798	7	R936	9	W701	5
R333	4	R429	4	R532	5	R799	7	R937	9	W755	7
R334	4	R430	4	R533	5	R804	9	R938	9	W903	9
R335	4	R432	4	R534	5	R805	9	R939	9	W971	9
R336	4	R433	4	R535	5	R806	9	R940	9	W972	9
R337	4	R434	4	R536	5	R818	9	R941	9	W984	9
R338	4	R435	4	R537	5	R819	9	R942	9	W985	9
R339	4	R436	4	R538	2	R820	9	R943	9	W987	9
R340	4	R437	4	R539	2	R821	9	R944	9	W989	9
R343	4	R438	4	R540	2	R822	9	R945	9	W991	9
R344	4	R439	4	R541	2	R823	9	R946	9	W993	9
R345	4	R440	4	R542	2	R824	9	R947	9	W1001	2
R346	4	R441	4	R543	2	R825	9	R952	9	W1002	2
R347	4	R442	4	R544	2	R828	7	R953	9	W1003	2
R348	4	R443	4	R545	2	R832	9	R965	9	W1005	2
R349	4	R444	4	R547	2	R834	9	R966	9	W1006	9
R351	4	R445	4	R548	2	R835	9	R967	9	W1007	9
R352	4	R446	4	R549	2	R836	9	R968	9	W1008	5
R353	4	R447	4	R550	5	R840	9	R969	9		
R354	4	R448	4	R551	5	R841	9	R975	9		
R355	4	R449	4	R552	5	R842	9	R976	9		

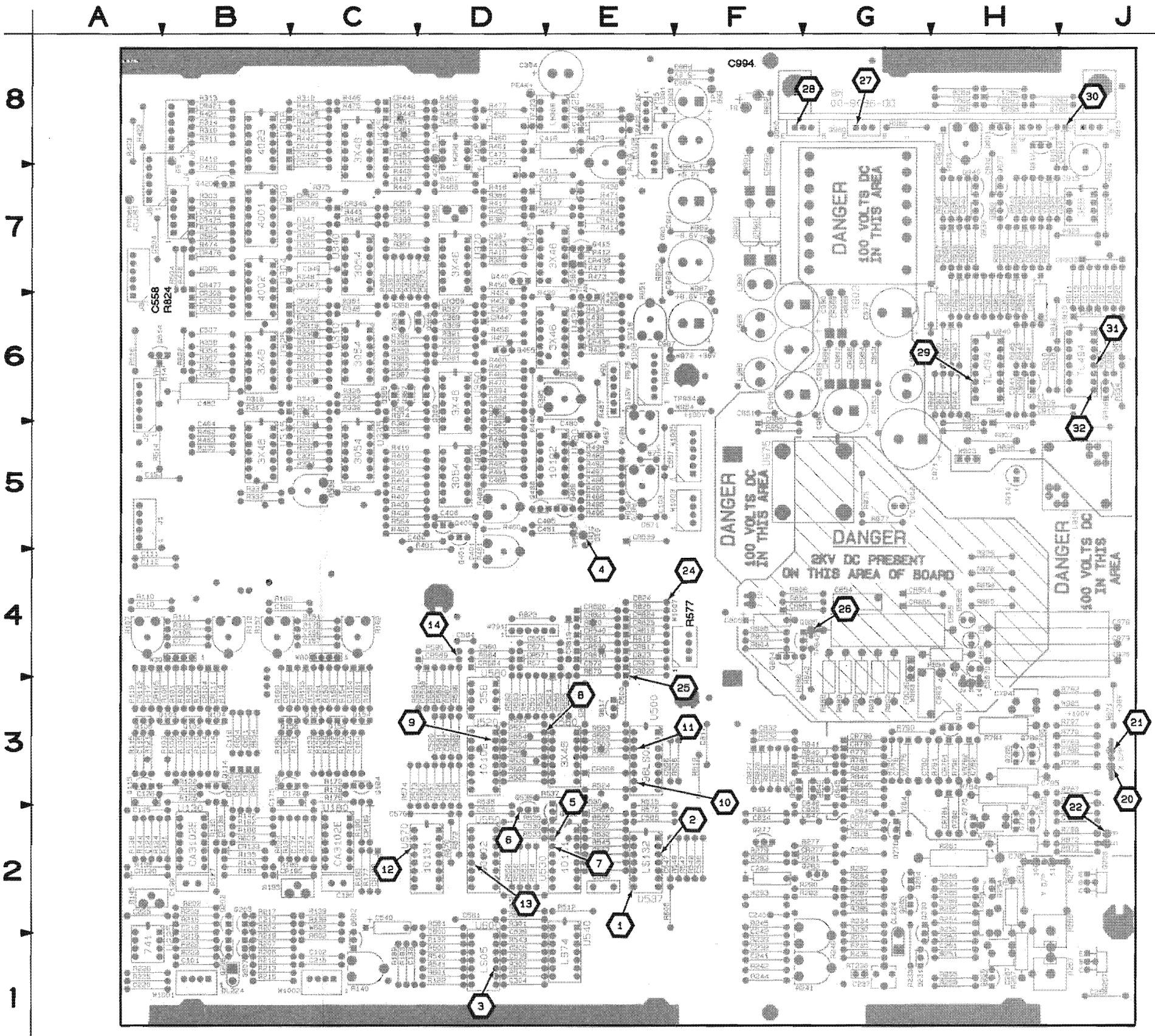
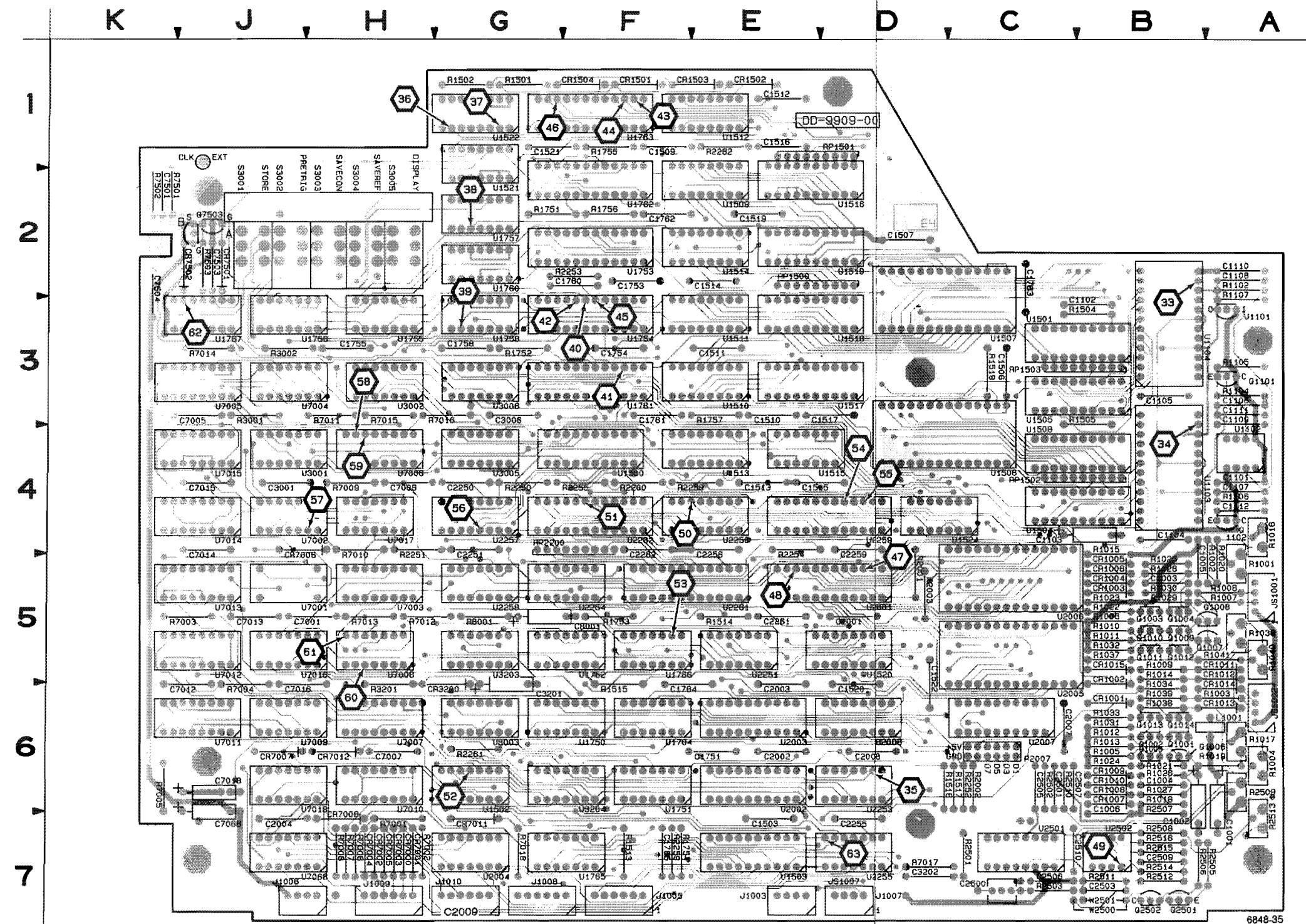
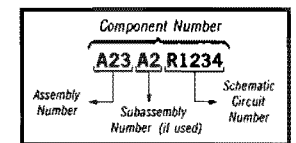


Figure 9-9. A1—Main board circuit view.



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

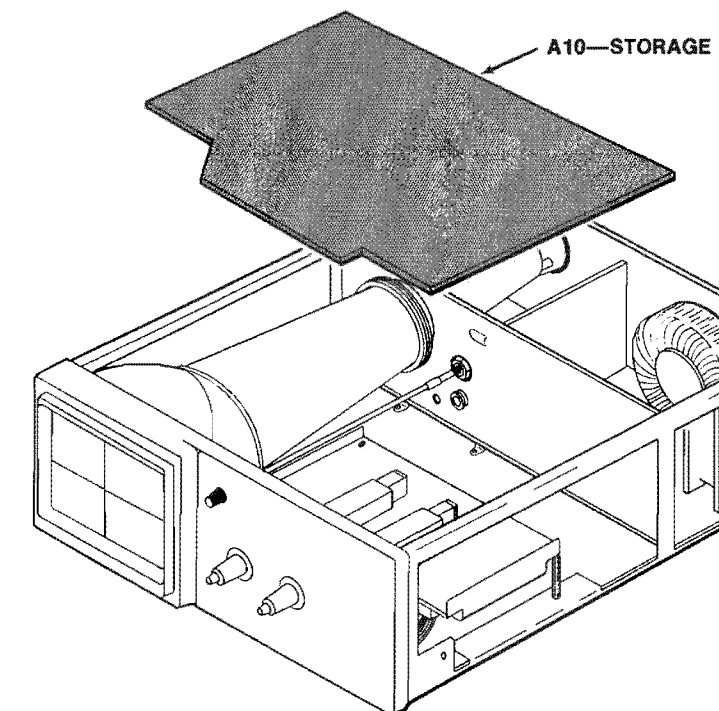


Figure 9-10. A10—Storage board.

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	11	C2510	17	J1006	9	R1041	11	R7018	19	U1765	13
C1002	11	C3001	20	J1007	9	R1102	11	R7501	19	U1765	15
C1003	11	C3006	20	J1008	5	R1104	11	R7502	19	U1765	18
C1004	11	C3201	20	J1009	6	R1105	11	R7503	19	U1766	15
C1005	11	C3202	20	J1010	6	R1106	11	R8001	20	U1766	18
C1006	11	C7000	19			R1107	11			U1767	19
C1101	11	C7001	19	L1001	11	R1501	14	RP1500	14	U2001	17
C1102	11	C7002	19			R1502	14	RP1501	14	U2002	17
C1103	11	C7003	19	P2007	17	R1504	13	RP1502	13	U2003	17
C1104	11	C7004	19			R1505	13	RP1503	13	U2004	17
C1105	11	C7005	19	Q1001	11	R1513	15	RP2200	18	U2004	19
C1106	11	C7006	19	Q1002	11	R1514	15			U2004	20
C1107	11	C7007	19	Q1003	11	R1515	13	S3001	20	U2005	17
C1108	11	C7008	19	Q1004	11	R1516	13	S3002	20	U2006	17
C1109	11	C7009	19	Q1005	11	R1517	13	S3003	20	U2007	17
C1110	11	C7010	19	Q1006	11	R1519	13	S3004	20	U2008	18
C1111	11	C7011	19	Q1007	11	R1751	15	S3005	20	U2251	18
C1112	11	C7012	19	Q1008	11	R1752	15			U2253	13
C1503	13	C7013	19	Q1009	11	R1753	15	U1101	11	U2253	18
C1506	13	C7014	19	Q1010	11	R1754	15	U1102	11	U2254	18
C1507	13	C7015	19	Q1011	11	R1755	15	U1103	11	U2255	18
C1509	13	C7016	19	Q1012	11	R1756	15	U1104	11	U2255	19
C1510	13	C7017	19	Q1013	11	R1757	15	U1500	18	U2255	20
C1511	13	C7018	19	Q1014	11	R2001	17	U1501	13	U2256	18
C1512	13	C7066	19	Q1101	11	R2002	17	U1502	13	U2257	18
C1513	13	C7501	19	Q1102	11	R2003	17	U1502	15	U2258	18
C1514	13	C7502	19	Q2501	17	R2200	18	U1502	18	U2259	18
C1515	13	C7503	19	Q2502	17	R2250	18	U1502	20	U2261	18
C1516	13	C7504	19	Q7503	19	R2251	18	U1503	13	U2262	18
C1517	13	C8001	20			R2252	18	U1504	13	U2501	17
C1519	13			R1001	11	R2253	18	U1505	13	U2502	17
C1520	13	CR1001	11	R1002	11	R2254	18	U1506	13	U3001	13
C1521	15	CR1002	11	R1003	11	R2255	18	U1507	13	U3001	19
C1522	13	CR1003	11	R1004	11	R2256	18	U1508	13	U3001	20
C1751	15	CR1004	11	R1005	11	R2259	18	U1509	14	U3002	15
C1753	15	CR1005	11	R1006	11	R2261	18	U1510	14	U3002	20
C1754	15	CR1006	11	R1007	11	R2262	18	U1511	14	U3005	20
C1755	15	CR1007	11	R1008	11	R2501	17	U1512	14	U3006	13
C1756	15	CR1008	11	R1009	11	R2502	17	U1513	14	U3006	20
C1757	15	CR1009	11	R1010	11	R2503	17	U1514	14	U3203	19
C1758	15	CR1010	11	R1011	11	R2505	17	U1515	13	U3203	20
C1759	15	CR1011	11	R1012	11	R2506	17	U1515	14	U3204	13
C1760	15	CR1012	11	R1013	11	R2507	17	U1516	14	U3204	18
C1761	15	CR1013	11	R1014	11	R2508	17	U1517	14	U3204	20
C1762	15	CR1014	11	R1015	11	R2509	17	U1518	14	U7001	19
C1763	15	CR1015	11	R1016	11	R2510	17	U1519	14	U7002	15
C1764	15	CR1501	14	R1017	11	R2511	17	U1520	13	U7002	19
C1765	15	CR1502	14	R1018	11	R2513	17	U1521	15	U7003	19
C1767	19	CR1503	14	R1019	11	R2516	17	U1521	19	U7004	19
C2001	17	CR1504	14	R1020	11	R3001	20	U1522	14	U7005	19
C2002	17	CR3200	20	R1021	11	R3002	20	U1524	13	U7006	19
C2003	17	CR7000	19	R1022	11	R3201	20	U1524	15	U7007	19
C2004	19	CR7001	19	R1023	11	R7001	19	U1524	18	U7008	19
C2007	17	CR7002	19	R1024	11	R7002	19	U1750	15	U7009	19
C2008	18	CR7003	19	R1025	11	R7003	19	U1750	18	U7010	19
C2009	20	CR7004	19	R1026	11	R7004	19	U1751	15	U7011	19
C2250	18	CR7005	19	R1027	11	R7005	19	U1752	15	U7012	19
C2251	18	CR7006	19	R1028	11	R7006	19	U1753	15	U7013	19
C2255	19	CR7007	19	R1029	11	R7007	19	U1754	15	U7014	19
C2256	18	CR7008	19	R1030	11	R7008	19	U1755	15	U7015	19
C2259	18	CR7011	19	R1031	11	R7009	19	U1756	15	U7016	19
C2261	18	CR7012	19	R1032	11	R7010	19	U1757	15	U7017	19
C2262	18	CR7501	19	R1033	11	R7011	19	U1758	15	U7018	19
C2500	17	CR7502	19	R1034	11	R7012	19	U1760	15	U7066	19
C2501	17			R1036	11	R7013	19	U1761	15	U8003	20
C2503	17	J1001	2	R1037	11	R7014	19	U1762	15		
C2505	17	J1002	2	R1038	11	R7015	19	U1763	15	W2500	17
C2506	17	J1003	2	R1039	11	R7016	19	U1764	15		
C2507	17	J1005	2	R1040	11	R7017	19	U1764	18		

VERTICAL PREAMPLIFIER AND CHANNEL SWITCH DIAGRAM 2

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
C101	2L	1B	CR162	8C	3B	R117	1D	3A	R178	7D	4C
C102	8L	1C	CR183	7K	2C	R118	1D	3B	R180	7H	2C
C103	4L	5E	CR186	6J	2B	R119	3D	3A	R181	8H	2C
C108	1C	4B	CR189	7J	2C	R120	2F	3B	R182	6J	1D
C107	3C	4B	CR539	6E	4E	R121	2F	3A	R183	6K	1C
C110	2D	4A	CR601	3J	2B	R122	2G	2B	R185	8J	2C
C111	2F	4A	CR602	3K	2B	R124	1G	2A	R186	6J	2B
C112	1F	4A	CR651	4J	2B	R125	2G	2B	R188	6K	2B
C114	1F	3B	CR652	4K	2B	R126	1G	2B	R189	5K	1C
C115	3F	3A				R127	2H	2B	R192	6K	2B
C116	2F	3B	E102	2B	3B	R128	2D	4B	R193	6K	2B
C124	2G	2A	E103	2B	3A	R130	1H	2B	R194	7K	2B
C125	2G	2A	E152	7C	3C	R131	2H	2A	R195	8K	2B
C126	2G	2A	E153	8C	3C	R132	5J	1D	R538	4G	1D
C130	2H	2B				R133	4K	1C	R539	6E	1D
C133	6J	1C	J1011	1L	1B	R135	1H	2B	R540	5J	1D
C153	8F	5A	J1012	7L	1C	R136	3J	2A	R541	5H	1D
C158	6C	4C				R138	3J	2A	R542	5G	1D
C157	8C	4C	Q102	2B	3B	R139	5K	1C	R543	5G	1D
C180	7D	4B	Q103	3B	3A	R140	5K	1C	R544	5E	2E
C164	7F	3C	Q104	1D	3B	R142	3K	2B	R545	5E	2E
C165	8F	3B	Q105	3D	3A	R143	3K	2B	R547	4F	2F
C174	8G	2B	Q114	1G	2B	R150	7B	3C	R548	4F	2E
C175	8G	2B	Q115	2G	2A	R151	8B	3C	R549	4G	2F
C176	8H	2B	Q152	7B	3C	R152	7B	3C	R581	4E	1D
C180	7H	2C	Q153	8B	3C	R153	8B	3C	R600	5H	1D
C536	5F	2F	Q154	7D	3C	R154	7C	3C	R601	5H	1D
C537	6H	2E	Q155	8D	3B	R155	8C	3C	R602	4H	1C
C538	4F	1D	Q164	7G	2C	R156	7C	3C	R603	3J	2B
C539	6F	1D	Q165	8G	2B	R157	7C	4B	R604	4K	3B
C545	5E	2E	Q602	4H	1C	R158	7B	3C	R605	4E	1E
C547	4F	2E				R159	8B	3C	R653	4J	2B
C561	4D	1D	R100	1B	3B	R160	7C	4B	R654	4K	3B
C582	5D	7B	R101	3B	3B	R161	8C	4C			
C600	6H	1D	R102	1B	3B	R162	8D	4C	U130	1J	2B
C601	4J	3B	R103	2B	3A	R164	7F	3C	U180	7J	2C
			R104	2C	3B	R165	8F	3B	U537	5E	2E
CR104	1C	3B	R105	2C	3A	R167	7D	3B	U540	5F	1E
CR105	2C	3A	R106	2C	3B	R168	6D	3C	U600	5H	1D
CR111	1C	3B	R107	2C	4A	R169	8D	3B			
CR112	2C	3A	R108	2B	3B	R170	7G	3C	W30	1A	3B
CR133	1J	2B	R109	2B	3B	R171	8G	3B	W80	7A	3C
CR136	3J	2A	R110	2C	4A	R172	7G	2C	W802	4J	1C
CR139	2J	2B	R111	2C	4B	R174	7G	2C	W1001	1L	1B
CR154	7C	3C	R112	2D	4B	R175	7G	2C	W1002	2L	1C
CR155	8C	3C	R114	1F	3B	R176	7H	2C	W1003	3L	5F
CR161	7C	3C	R115	2F	3A	R177	7H	2C	W1005	3C	5F

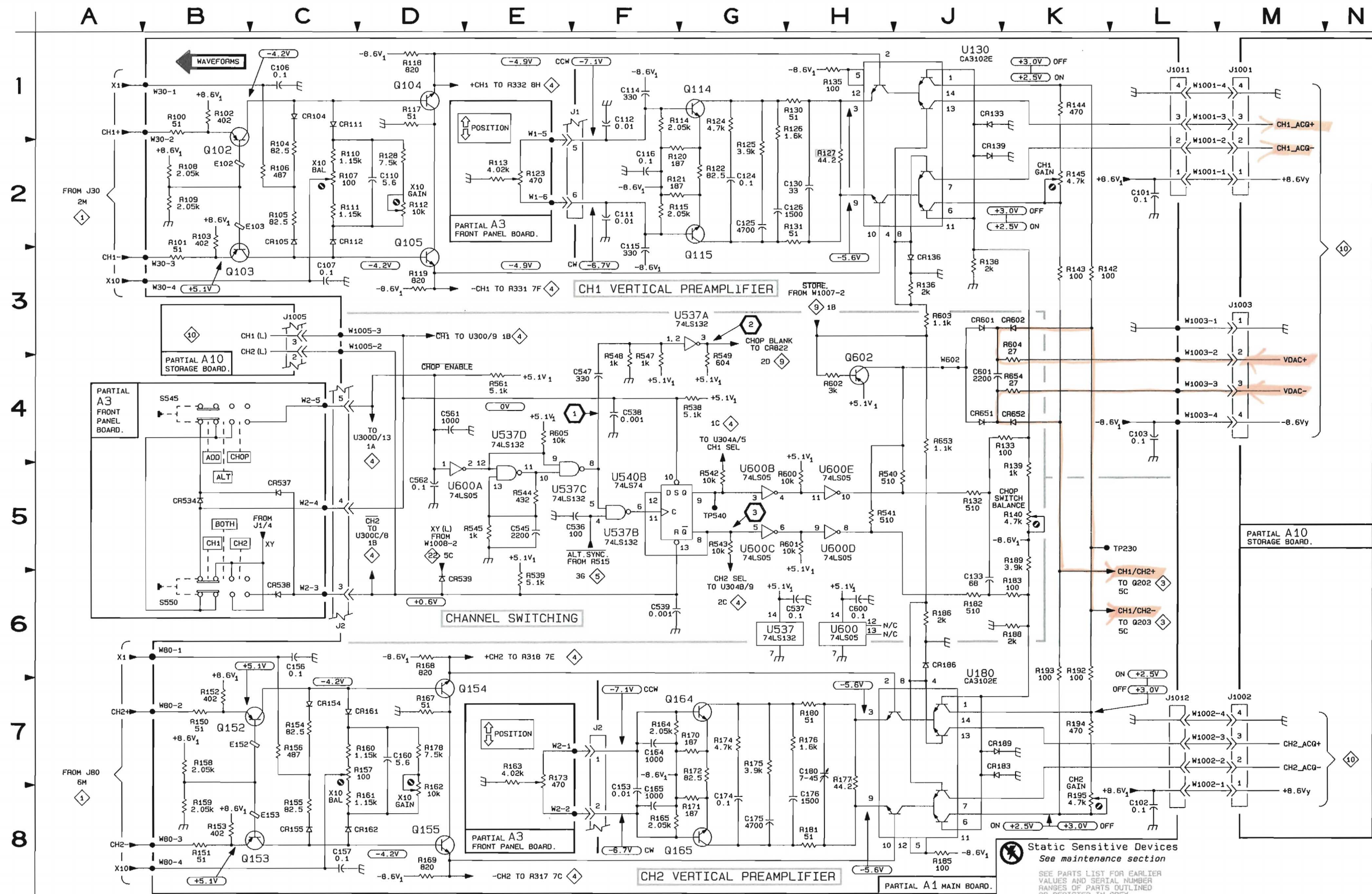
Partial A1 also shown on diagrams 3, 4, 5, 7, 8 and 9.

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
CR534	5B	2C	R113	2E	1B	R163	7E	1C	S545	4B	2C
CR537	5C	2C	R123	2E	1B	R173	7E	1C	S550	6B	2B
CR538	6C	2B									

Partial A3 also shown on diagrams 1, 3, 5, 8 and 9.

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	1M	5A	J1002	7M	6A	J1003	3M	7E	J1005	3C	7F

Partial A10 also shown on diagrams 5, 6, 9, 11, 13, 14, 15, 17, 18, 19 and 20.

VERTICAL PREAMPLIFIER
AND CHANNEL SWITCH

2

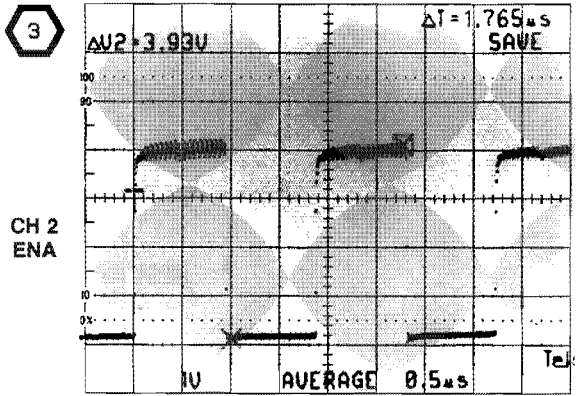
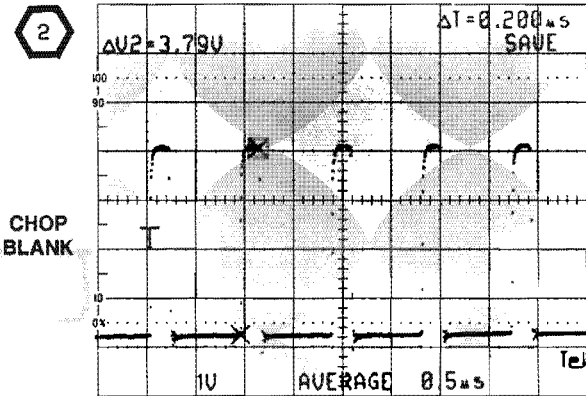
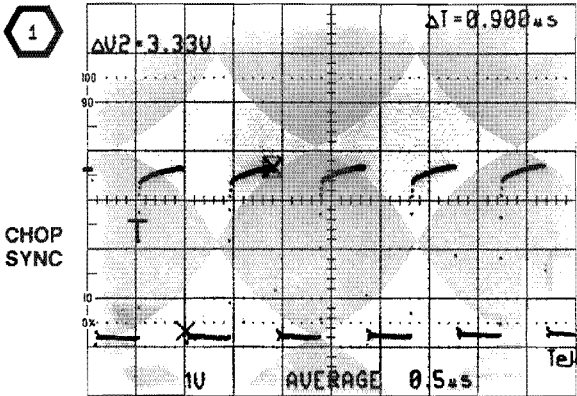
VERTICAL PREAMPLIFIER AND CHANNEL SWITCH

2

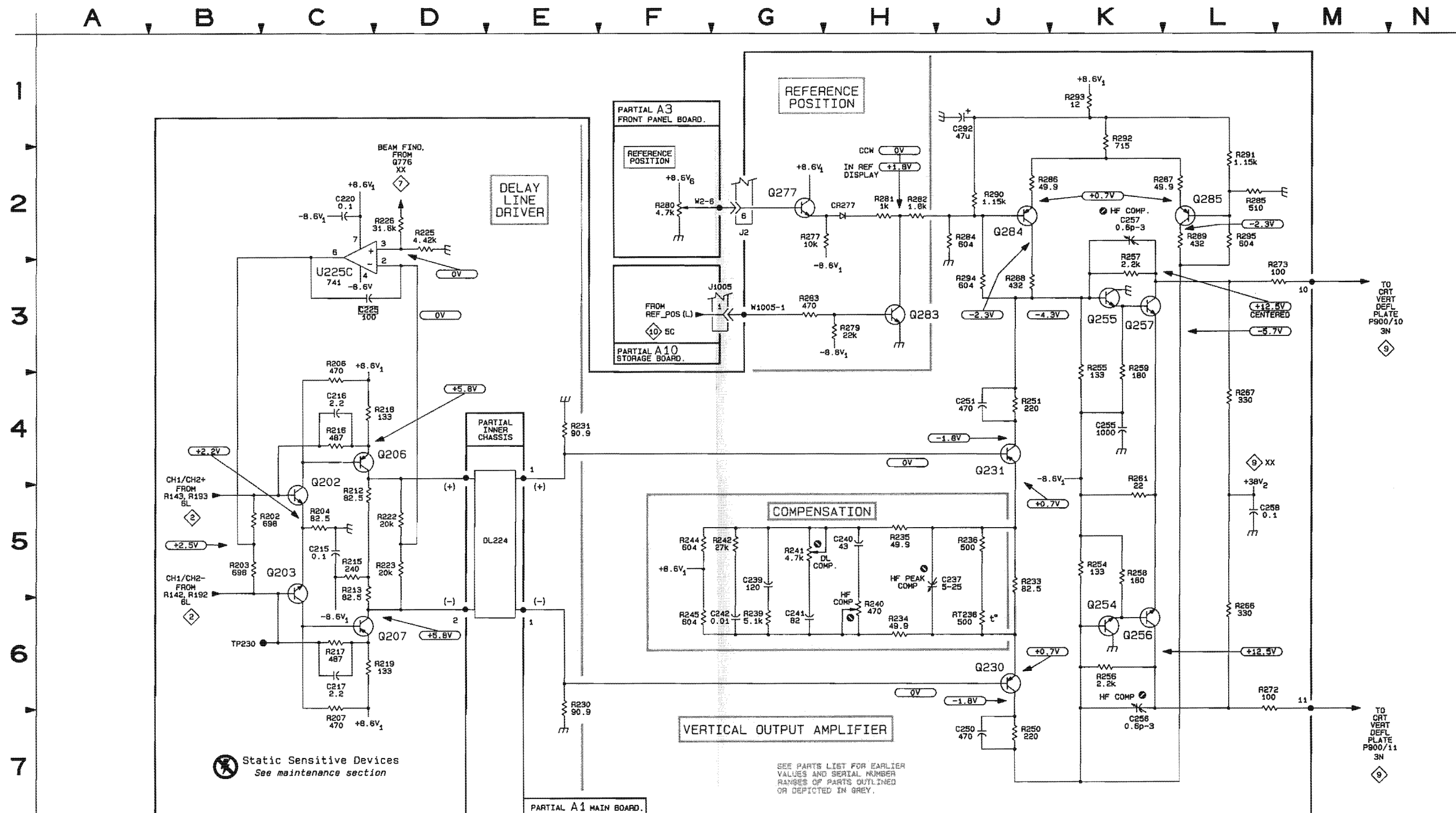
WAVEFORMS FOR DIAGRAM 2

2210 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



WAVEFORMS FOR DIAGRAM 2



TRIGGER DIAGRAM 4

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
C304	1C	1D	CR444	7J	7C	R347	6B	7C	R424	4J	6D
C305	2C	1D	CR445	7J	7C	R348	6B	6C	R425	4J	6E
C310	7D	6C	CR446	6J	8C	R349	7A	7C	R427	4K	7D
C335	7G	5C	CR447	5L	6D	R351	7C	7C	R428	4K	7E
C340	7B	7C	CR474	2B	7B	R352	7C	7C	R429	4K	8E
C349	7A	6C	CR475	2B	7B	R353	3E	6C	R430	4L	8E
C351	7C	7C	CR476	2E	7B	R354	7B	6B	R432	4L	7D
C353	3F	6C	CR477	2D	6B	R355	7B	7C	R433	4L	7D
C369	4E	6D				R356	7B	7C	R434	4H	6E
C372	4F	6D	Q363	3D	6C	R357	8B	6B	R435	4J	6E
C380	5F	5D	Q365	3E	6C	R358	8B	6B	R436	4H	6E
C384	5E	8D	Q366	3E	6C	R359	6C	7C	R437	4J	6D
C387	5F	5F	Q367	3F	6C	R360	7C	7D	R438	4J	7E
C389	3G	3G	Q368	3D	6D	R361	3D	6D	R439	4J	6D
C396	4G	4G	Q400	1G	4D	R362	4D	6C	R440	8L	6D
C398	5J	5J	Q401	1G	4D	R363	3E	6C	R441	8L	6C
C400	1G	1G	Q415	3K	7E	R364	3E	5C	R442	6J	8C
C401	1G	1G	Q420	8J	7B	R366	3F	6C	R443	6J	8C
C408	1F	5D	Q435	4J	6E	R367	3F	6C	R444	6J	8C
C418	3K	7D	Q440	8L	6D	R368	2F	6C	R445	6J	8C
C430	4L	8E	Q487	1K	5E	R369	4E	6D	R446	7K	8C
C431	4K	8E	Q488	1L	5D	R374	3F	5C	R447	7K	7C
C435	4J	6E	Q489	1L	5E	R375	8K	7C	R448	7K	7C
C439	4J	6E				R380	3G	5D	R449	8K	7C
C451	6L	8C	R300	1C	1D	R381	5F	6D	R450	6L	8C
C452	6L	8D	R301	2C	1D	R384	5F	7D	R451	7L	8C
C455	6M	8D	R303	2B	7B	R385	5G	6C	R452	6M	7C
C460	6M	7D	R304	2C	7B	R386	5E	7D	R453	7M	7C
C462	5N	6B	R308	2B	7B	R387	5F	7D	R454	7L	8D
C471	6N	7D	R309	1D	6B	R388	4E	6C	R455	6M	8D
C472	6N	7D	R310	3B	8B	R389	3F	5C	R456	7L	8D
C473	5M	7D	R311	4B	8B	R390	4F	6D	R457	6M	6D
C480	8E	5E	R312	4B	8C	R391	4F	6D	R458	6M	6D
C481	1H	4D	R313	4B	8B	R392	5G	6C	R459	8L	6D
C489	1K	5D	R314	4B	8B	R393	5G	6C	R460	6M	8D
C495	1M	4D	R316	7D	6C	R394	4G	5D	R461	6M	7D
C496	1M	5E	R317	7D	5B	R395	4G	5E	R462	5N	5B
			R318	7E	5B	R396	4G	5D	R468	5M	7D
CR300	1D	6C	R319	8D	6C	R397	6G	6C	R470	5M	6D
CR301	1D	5C	R320	8E	6C	R398	6H	7C	R472	6N	6E
CR302	2D	6C	R321	8D	6B	R400	1G	4C	R473	6N	6E
CR303	2B	6B	R322	7D	6C	R401	1H	4D	R474	2E	7B
CR304	2C	6B	R323	7E	6C	R402	3G	5C	R475	5L	8C
CR306	2B	6B	R325	8D	5C	R403	2H	5C	R476	1E	6B
CR319	6D	6C	R326	6E	5C	R404	2G	5C	R477	7L	8D
CR344	6G	5C	R327	6G	6D	R405	2G	5C	R478	7L	7E
CR347	6B	6C	R328	6H	6E	R406	1F	5C	R480	1H	4D
CR348	6C	7C	R329	6E	6C	R407	1G	5C	R481	1H	4D
CR349	6C	7C	R330	6E	6C	R408	1G	5B	R482	1J	5D
CR357	8B	6B	R331	7F	5B	R409	2G	5C	R483	1K	5D
CR369	4E	6D	R332	7H	5B	R410	2G	5C	R485	1K	5D
CR370	4F	6C	R333	8G	5C	R412	2J	7E	R486	1L	5D
CR417	3J	7D	R334	8G	5C	R413	3J	7E	R487	1L	5E
CR420	8J	7C	R335	8H	5B	R414	3J	7E	R488	1L	5E
CR421	8J	8B	R336	7G	5C	R415	3K	7D	R489	2K	5D
CR431	4K	7E	R337	7H	5C	R416	3L	7D	R490	1L	5E
CR432	8J	7C	R338	7G	5C	R417	3H	7D	R491	2L	5D
CR435	4J	6E	R339	6G	5C	R418	3L	7D	R492	1L	5E
CR438	4J	7E	R340	6H	5C	R419	8J	7B	R493	2L	5E
CR440	6L	8C	R343	6H	5C	R420	8J	7B	R495	1M	5E
CR441	7K	8C	R344	6H	5C	R421	8J	8B	R496	1M	5E
CR442	7K	7C	R345	6B	6C	R422	4L	8A	R497	2M	5E
CR443	6K	8C	R346	6B	7C	R423	2M	8A	R498	1N	5E

LOOKUP TABLE FOR DIAGRAM 4

TRIGGER DIAGRAM 4 (CONT)

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
U300A	2D	7B	U325B	8D	6B	U370D	5E	7D	U435E	4K	6E
U300B	1D	7B	U325C	8F	6B	U370E	8K	7D	U445A	7K	8C
U300C	1B	7B	U325D	8E	6B	U380A	4F	5D	U445B	7K	8C
U300D	1B	7B	U325E	7B	6B	U380B	4G	5D	U445C	7K	8C
U304A	1C	6B	U335A	6F	5C	U380C	4G	5D	U445D	7K	8C
U304B	2C	6B	U335B	7G	5C	U380D	4F	5D	U445E	6J	8C
U308A	4B	8B	U335C	7H	5C	U380E	5F	5D	U450A	6M	8C
U308B	2B	8B	U335D	7H	5C	U415A	3J	7D	U450B	7L	8C
U308C	3B	8B	U335E	7H	5C	U415B	3J	7D	U460A	2G	5D
U310A	6D	6C	U335F	7G	5C	U415C	6N	7D	U460B	2G	5D
U310B	7D	6C	U340A	6A	7C	U415D	3L	7D	U460C	2H	5D
U310C	6E	6C	U340B	7B	7C	U415E	5K	7D	U460D	2H	5D
U310D	6E	6C	U340C	6C	7C	U425A	4L	8E	U460E	3H	5D
U310E	7E	6C	U340D	6B	7C	U425B	3L	6E	U460F	2G	5D
U310F	6D	6C	U340E	7B	7C	U435A	4H	6E	U480A	2M	5E
U315B	7F	5B	U340F	6B	7C	U435B	4J	6E	U480B	2M	5E
U315C	8H	5B	U370B	5F	7D	U435C	6L	6E	U480C	2J	5E
U315D	8G	5B	U370C	4F	7D	U435D	6M	6E	U480D	2K	5E
U315E	5N	5B									

Partial A1 also shown on diagrams 2, 3, 5, 7, 8 and 9.



2210 Service

WAVEFORMS FOR DIAGRAM 5

2210 CONTROL SETTINGS

DC VOLTAGES

INTENSITY
HORIZONTAL MAG
SEC/DIV
TRIGGER MODE
STORE/NON-STORE

MIDRANGE
X1
0.1 ms
P-P AUTO
NON-STORE

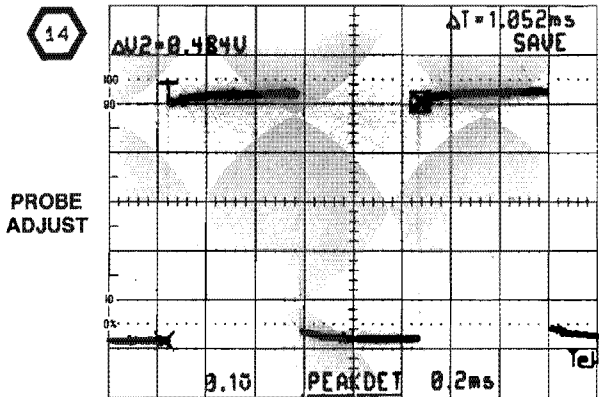
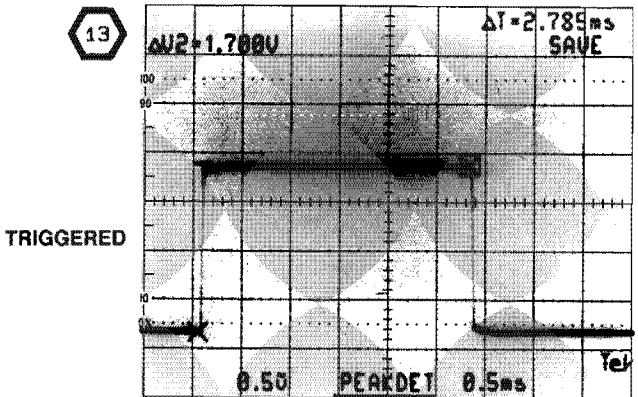
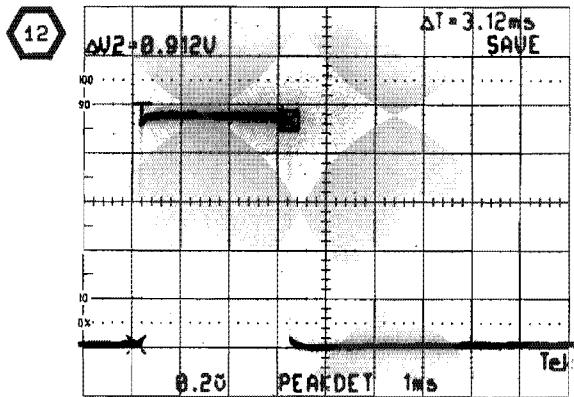
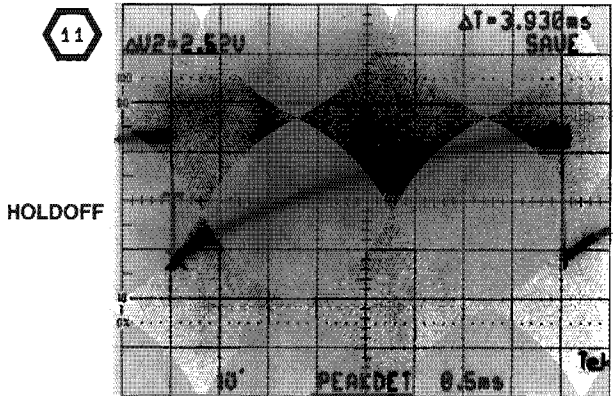
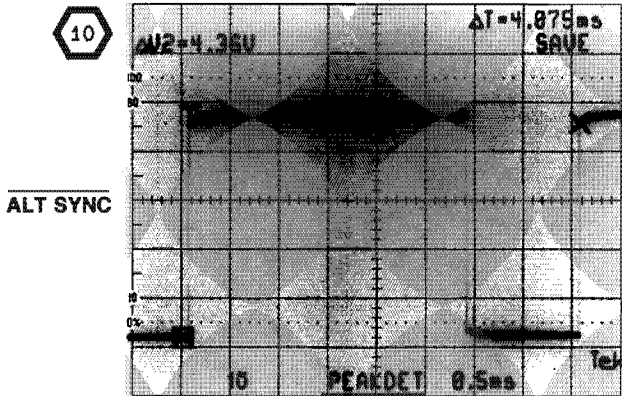
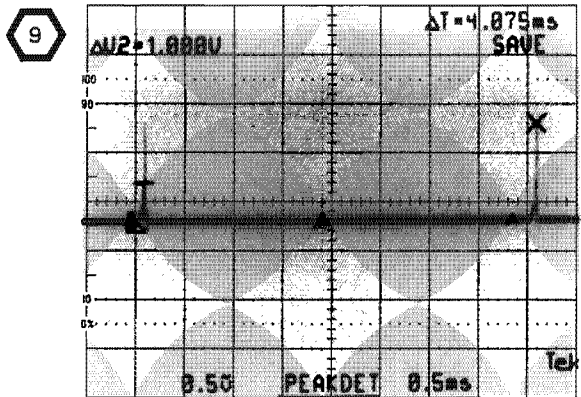
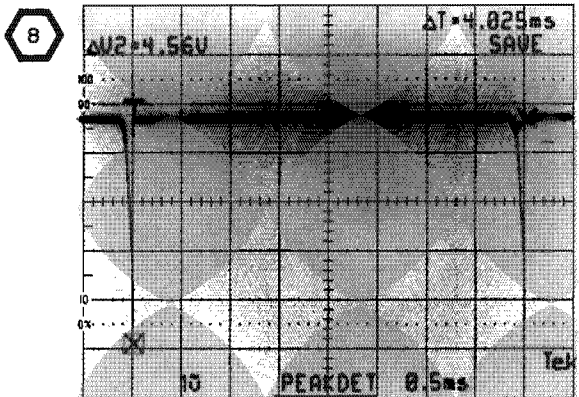
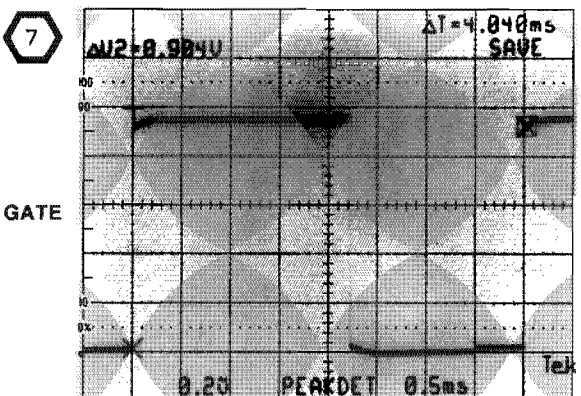
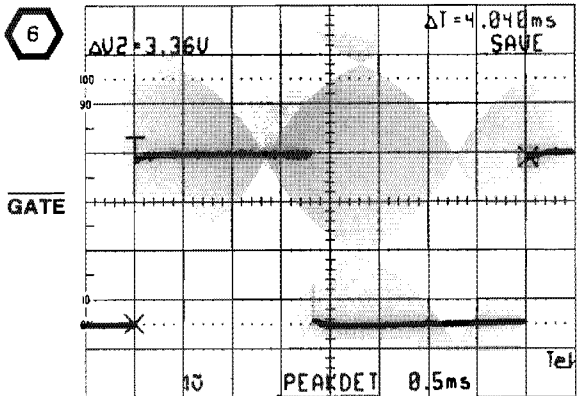
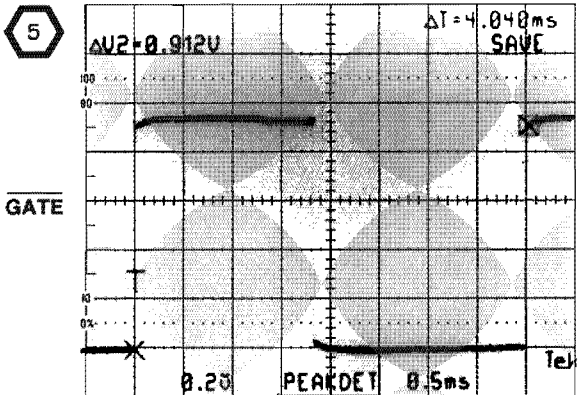
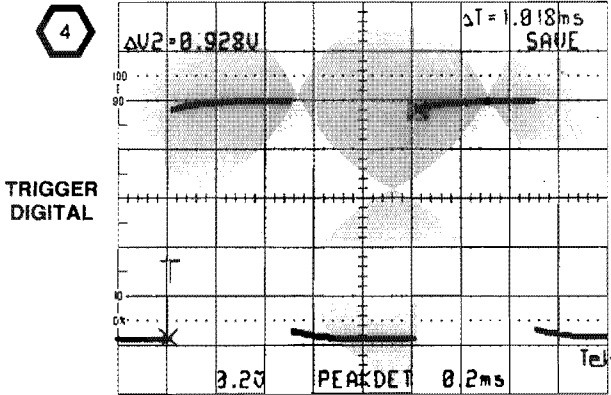
VERTICAL MODE
CH 2 VOLTS/DIV
CH 2 AC-GND-DC
HORIZONTAL MAG
SEC/DIV
STORE-NON STORE

AC WAVEFORMS

CH 2
1V
DC
X1
0.1 ms
NON-STORE

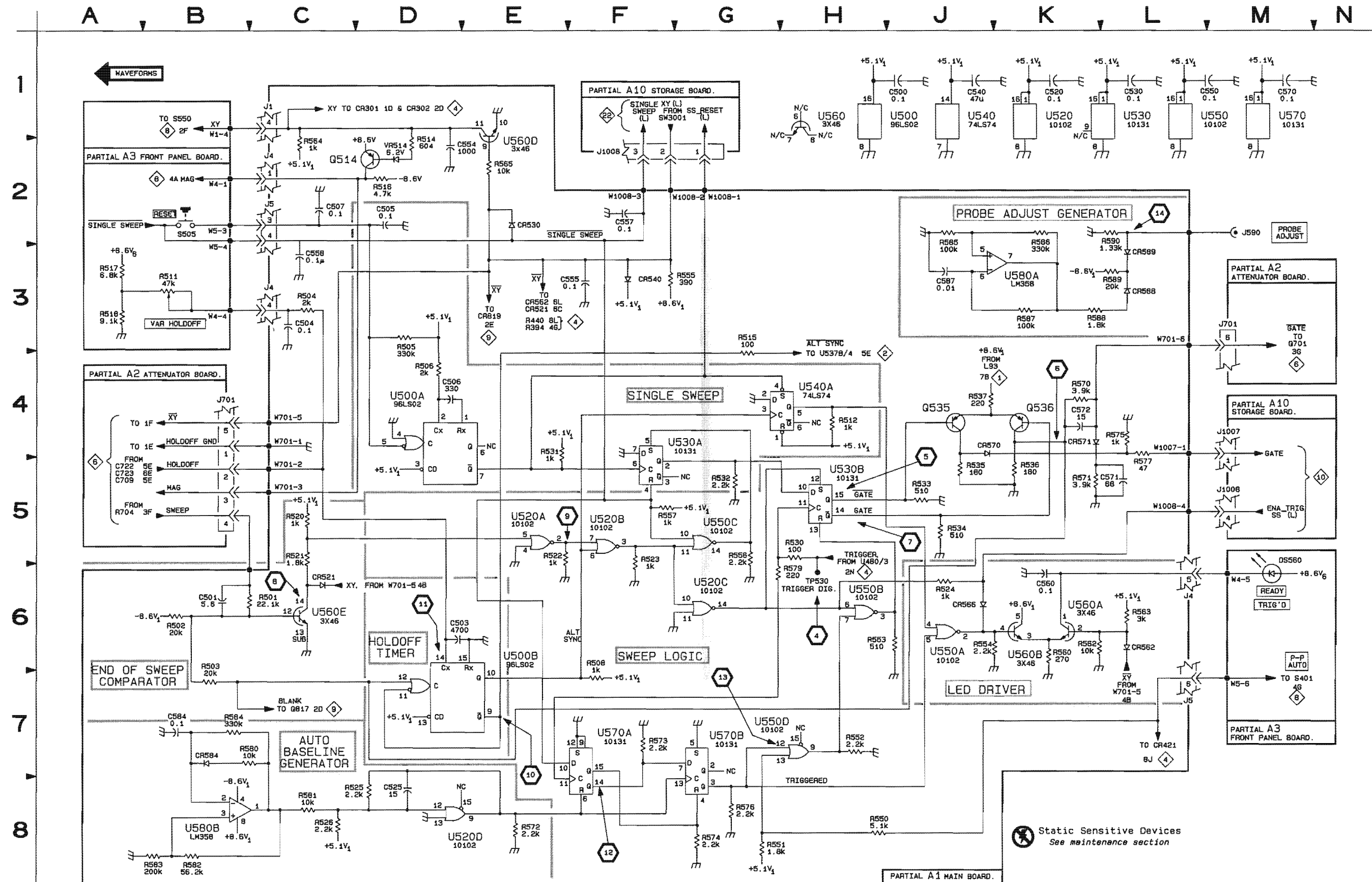
TRIGGER MODE
TRIGGER LEVEL
TRIGGER SOURCE
TRIGGER CPLG
CH 2 INPUT SIGNAL

P-P AUTO
MIDRANGE
CH 2
AC
4 V P-P SINE
WAVE AT 1 kHz



WAVEFORMS FOR DIAGRAM 5

MORE



WAVEFORMS FOR DIAGRAM 6

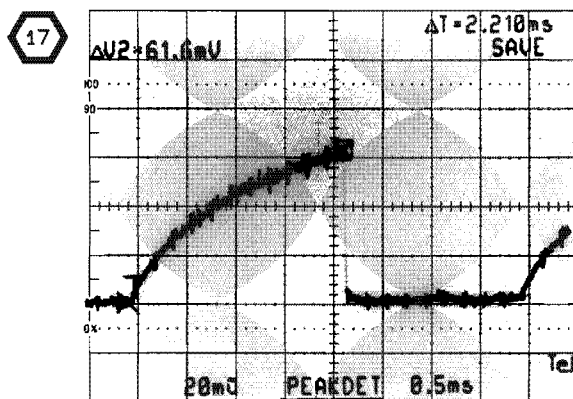
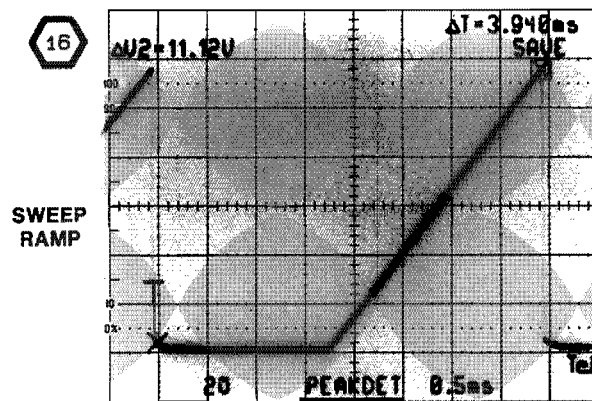
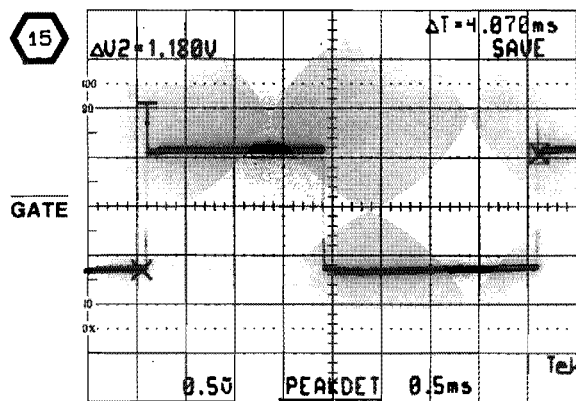
2210 CONTROL SETTINGS

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



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
C880	2J	4E	CR679	3L	5C	R671	5D	4C	R706	2H	6A
C884	7J	3E	CR688	7K	3D	R675	2J	4D	R707	2H	6A
C685	8K	3D	CR698	6C	5C	R676	4F	6B	R708	3H	6B
C888	6K	4D	CR699	6C	5C	R677	4G	6B	R709	2H	6B
C890	4C	3D	CR732	2J	6C	R678	3E	6C	R715	7E	4A
C897	7L	3D				R679	3L	5C	R716	7E	4A
C898	6L	4D	J90	1G	3E	R680	2L	4E	R717	8F	4A
C899	8L	3E	J701	1D	6C	R681	4L	5D	R718	8E	4A
C701	4F	5B				R682	3L	4E	R719	7G	4C
C702	5F	5A	L712	2G	2E	R683	7K	3E	R720	7G	4C
C703	3H	5B	L713	2G	3E	R684	7J	3D	R721	7G	4D
C704	3J	6B				R685	7K	3E	R722	7F	4C
C705	3K	6B	Q670	6D	4C	R686	7K	3E	R723	6F	5C
C706	4J	6B	Q680	2L	4E	R687	7K	4E	R732	1K	4E
C707	2H	6A	Q681	3L	5D	R688	6K	4E	R733	2L	4E
C708	4K	6B	Q684	7K	3E	R689	6K	4E	R734	2K	3D
C709	5E	5C	Q690	8K	4D	R690	6K	4D	R735	2K	4D
C712	2G	3D	Q694	5K	4E	R693	6K	3E	R736	1K	4E
C713	2G	3D	Q698A	8L	4D	R694	5K	4E	R737	1L	4D
C715	7E	5A	Q698B	7L	3D	R695	5L	4E	R740	3L	5C
C722	5E	5C	Q699	6M	4D	R696	5L	4E			
C723	6E	5C	Q701	3G	5B	R698	7L	4D	S701	4H	4B
C724	1L	4D	Q702	2H	5A	R699	6M	4E			
C732	2J	4E	Q704A	4K	5B	R700	4G	6B	U715	7G	4A
C733	1L	5E	Q704B	5K	5A	R701	6G	5B			
C734	3G	6C	Q706	4K	5B	R702	6G	6C	VR719	7F	4A
			Q732	2K	4D	R703	4F	5B			
CR676	4F	6B	Q737	2L	4D	R704	2F	6B	W1009	5B	4C
CR677	4F	5C				R705	4K	5B	W1010	8B	4D
CR678	3E	6C	R670	6D	4C						

Partial A2 also shown on diagrams 1 and 7.

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
J1009	5B	7H	J1010	8B	7G						

Partial A10 also shown on diagrams 2, 5, 9, 11, 13, 14, 15, 17, 18, 19 and 20.



SEE PARTS LIST FOR EARLIER
VALUES AND SERIAL NUMBER
RANGES OF PARTS OUTLINED
OR DEPICTED IN GREY.

2210 Service

WAVEFORMS FOR DIAGRAM 7

2210 CONTROL SETTINGS

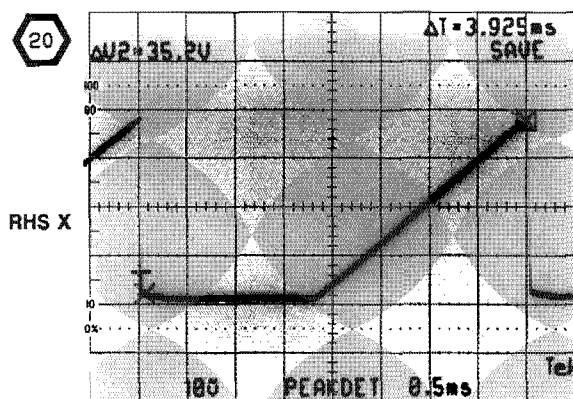
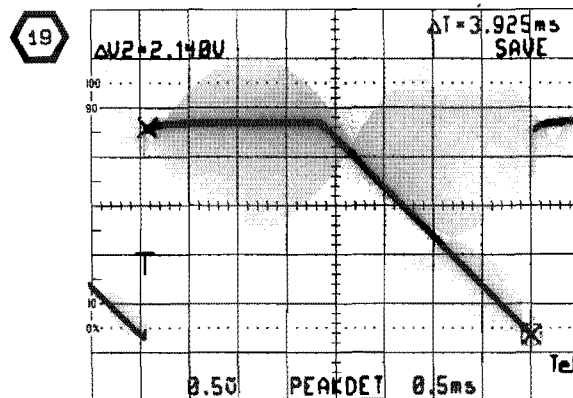
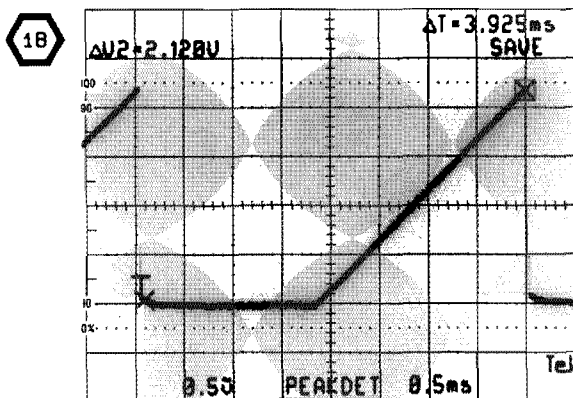
DC VOLTAGES

INTENSITY	MIDRANGE
HORIZONTAL MAG	X1
SEC/DIV	0.5 ms
TRIGGER MODE	P-P AUTO
STORE/NON-STORE	NON-STORE

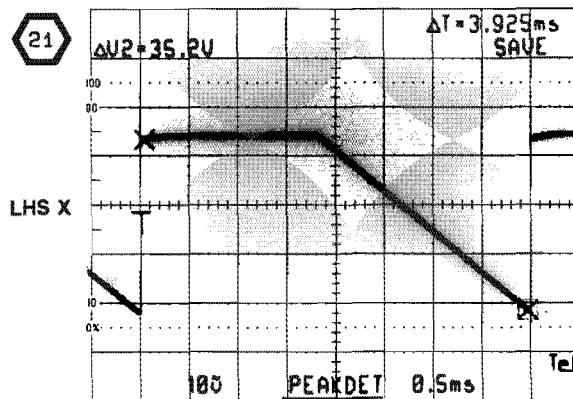
AC WAVEFORMS

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

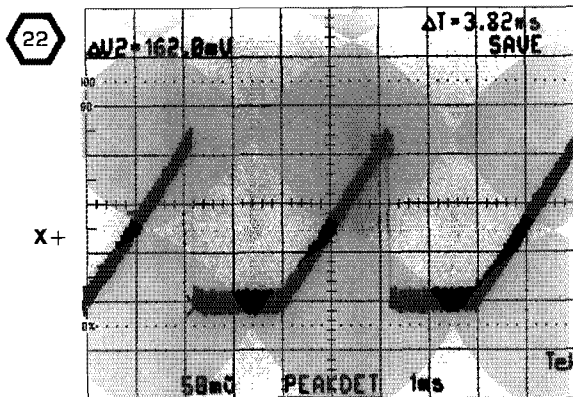
WAVEFORMS FOR DIAGRAM 7



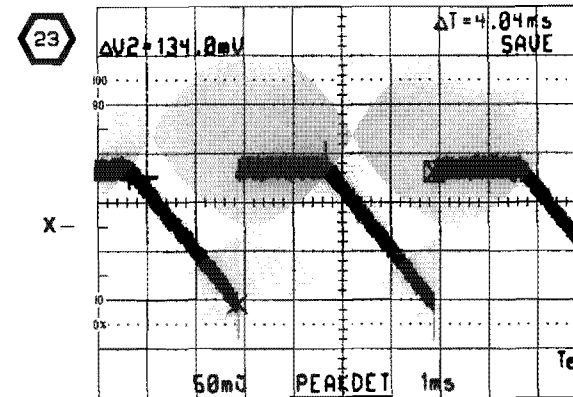
RHS X



LHS X



X+



X-

X-AXIS AMPLIFIER DIAGRAM 7

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	4K	3G	CR790	7J	3G	R776	4J	3G	R792	6K	3J
C780	5K	3G	CR791	5K	3H	R778	5M	2J	R794	6L	3H
C782	5K	3H				R779	5M	3J	R795	6L	3H
C784	4K	2H	Q770	3K	2H	R780	4K	3G	R796	7L	3J
C785	3L	2H	Q775	4L	2H	R781	4K	3G	R797	6M	3J
C789	4M	2J	Q778	6J	2G	R784	4L	2H	R798	5L	3J
C794	6K	3H	Q779	4L	2H	R785	4L	2H	R799	5M	3J
C795	5L	3H	Q780	5K	3H	R786	5L	2H	R828	6K	2G
C799	6M	3J	Q785	6L	3H	R787	4M	2J			
			Q789	6L	3H	R788	3L	2J	VR776	5J	3G
CR776	6J	2G				R789	5M	2J	VR792	5L	3H
CR780	4J	3G	R262	6J	2G	R790	5K	3G			
CR781	4K	2H	R764	6J	2G	R791	5K	3H	W755	3J	8E

Partial A1 also shown on diagrams 2, 3, 4, 5, 8 and 9.

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	5C	5D	Q748	5E	5D	R748	3E	6C	R769	5G	5E
C748	2D	4C	Q750	4D	5C	R749	3E	5C	R770	7G	5E
C755	7G	5E	Q759	4F	5E	R750	4E	5C	R771	7G	5E
C767	6G	5F	Q760	6E	5D	R751	4D	6D	R772	7G	5E
C773	8F	5E				R752	4E	5D	R773	8F	5E
C774	8F	5E	R711	6C	6D	R753	4E	6D	R774	8H	5E
			R712	5C	5D	R754	6D	5D	R775	4E	6D
CR747	4D	6D	R713	5C	5D	R755	6D	5D	R777	6G	4E
CR748	4E	6D	R714	5C	5D	R756	6E	5E	R782	3G	6E
CR755	8G	5E	R730	3D	6C	R757	2G	5E			
CR758	3G	6E	R731	3D	6C	R758	3G	6E	U745A	5A	5D
CR761	4G	6E	R738	3C	4C	R759	4F	6D	U745B	5C	5D
CR762	4G	6E	R739	2C	4C	R760	5E	5D	U745C	4F	5D
CR769	5G	5E	R741	5B	5D	R761	4G	6E	U745D	4H	5D
CR773	5F	5F	R742	5B	5D	R762	4G	6E	U745E	7F	5D
CR774	5H	5E	R743	5B	5D	R763	5G	5E	U755A	7H	5E
			R744	4B	5D	R765	5G	5E	U755B	6H	5E
J7	2C	3D	R745	5B	5D	R766	5F	4E	U755C	3F	5E
J755	2F	5F	R746	2D	5C	R767	6G	5E	U755D	3H	5E
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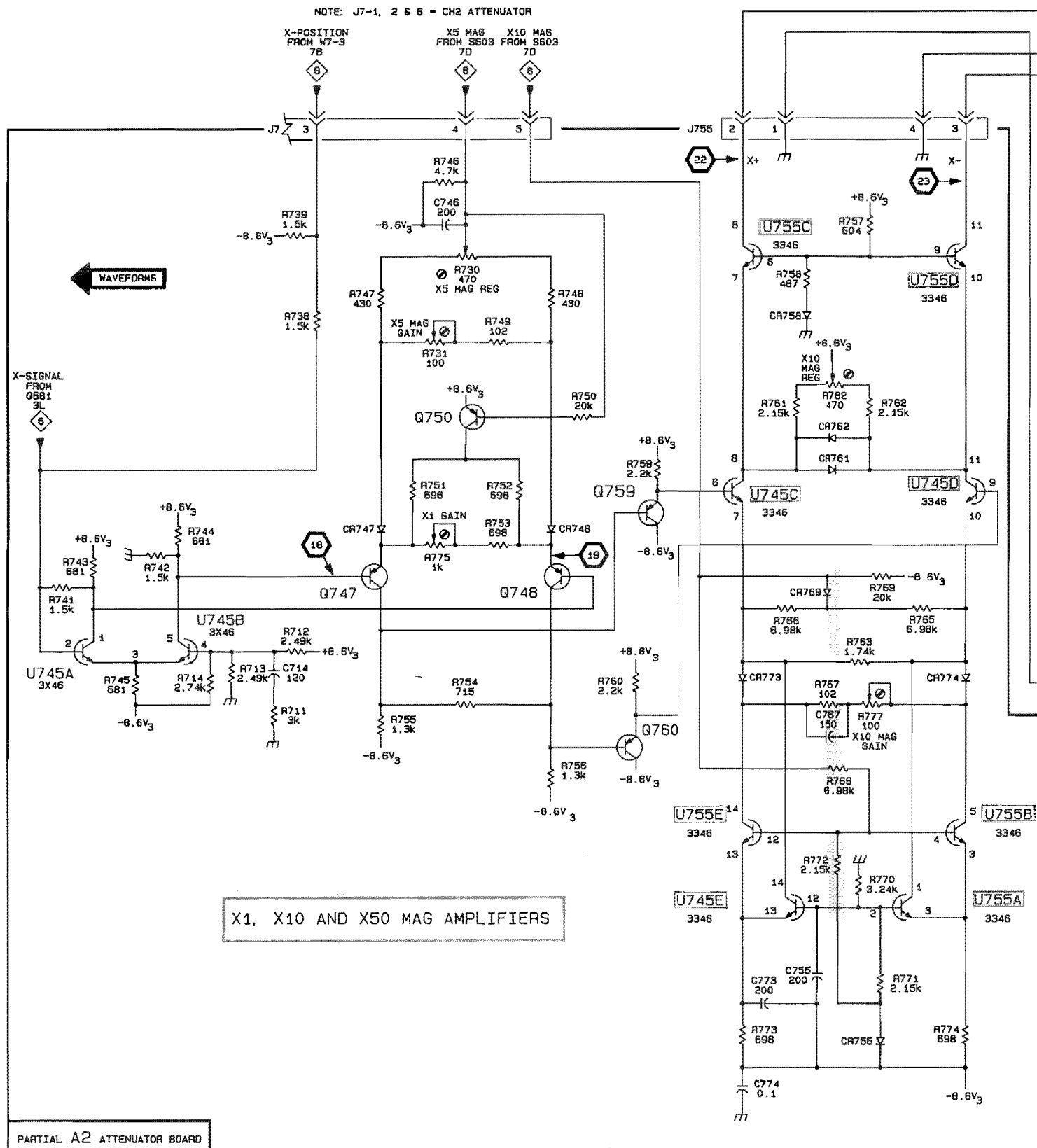
Partial A2 also shown on diagrams 1 and 6.

A B C D E F G H J K L M N

NOTE: J7-1, 2 & 5 = CH2 ATTENUATOR

X-POSITION
FROM W7-3X5 MAG
FROM S603X10 MAG
FROM S603

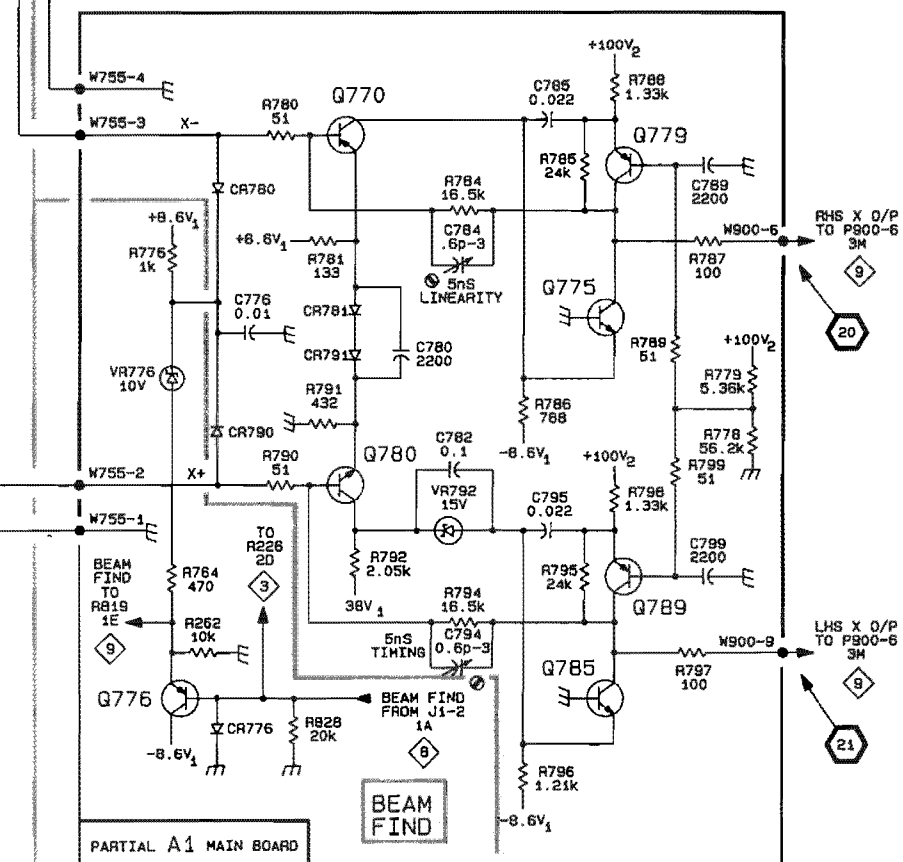
WAVEFORMS



X1, X10 AND X50 MAG AMPLIFIERS

PARTIAL A2 ATTENUATOR BOARD

HORIZONTAL OUTPUT AMPLIFIER



PARTIAL A1 MAIN BOARD

Static Sensitive Devices
See maintenance section

SEE PARTS LIST FOR EARLIER
VALUES AND SERIAL NUMBER
RANGES OF PARTS OUTLINED
OR DEPICTED IN GREY.

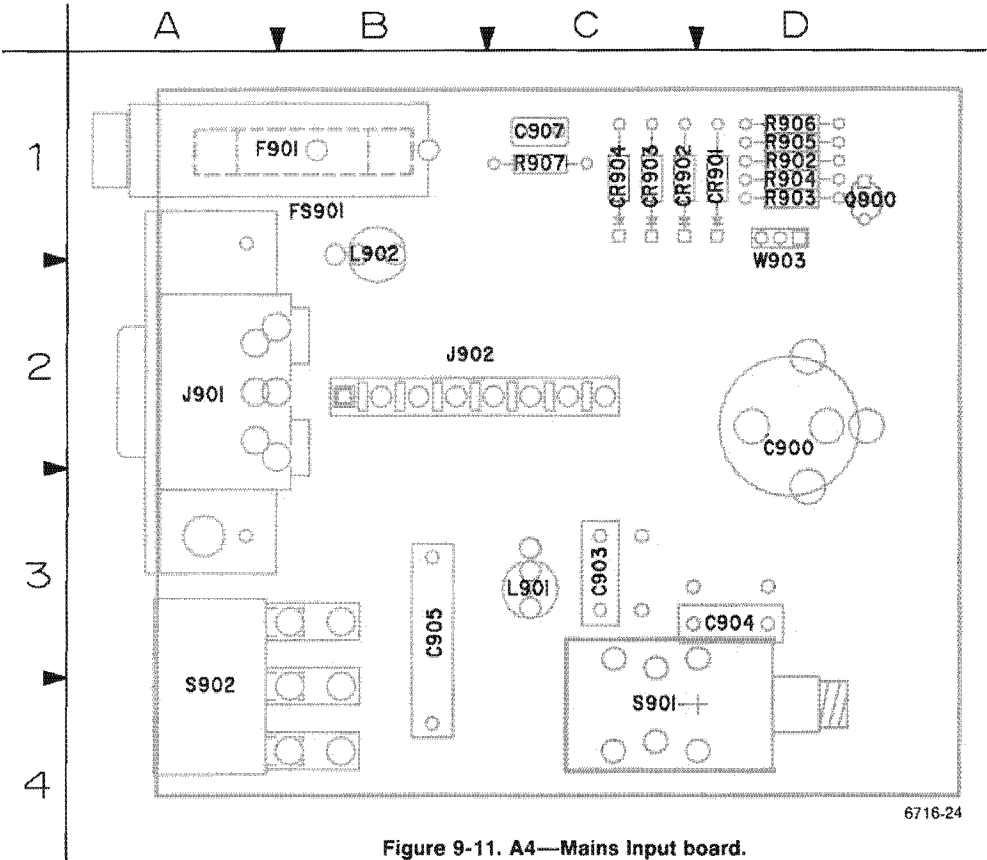


Figure 9-11. A4—Mains Input board.

A4—MAINS INPUT BOARD							
CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER	CIRCUIT NUMBER	SCHEM NUMBER
C900	9	CR904	9	P901	9	R905	9
C903	9	FS901	9	Q900	9	R906	9
C904	9	J902	9	R902	9	S901	9
C905	9	L901	9	R903	9	S902	9
CR901	9	L902	9	R904	9		
CR902	9						
CR903	9						

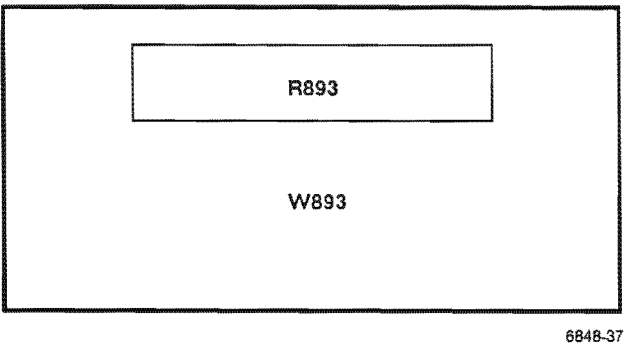
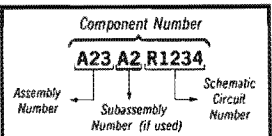


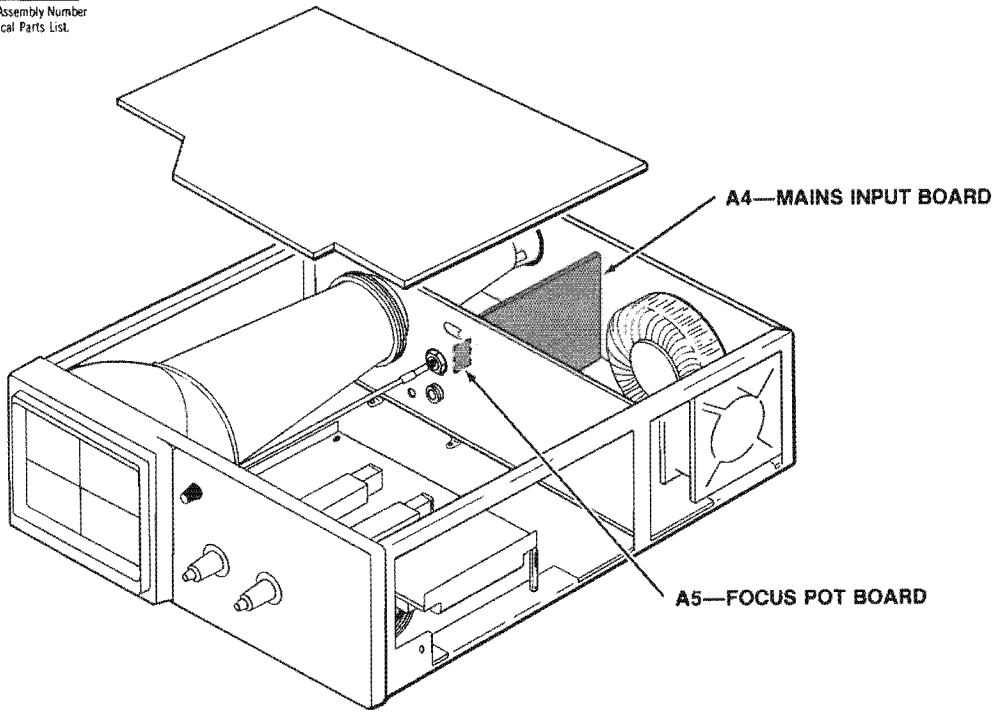
Figure 9-12. A5—Focus Pot board.

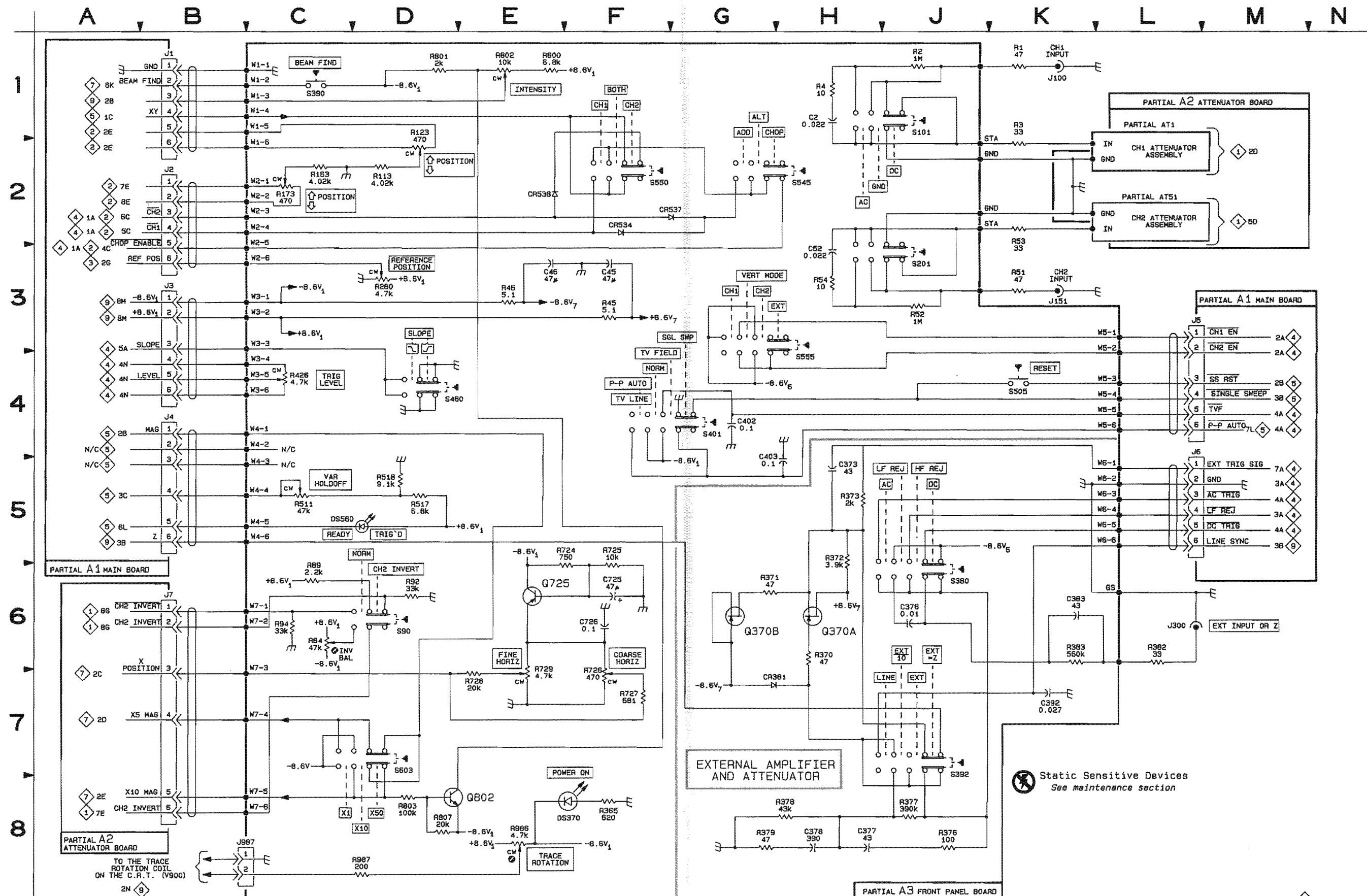
Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

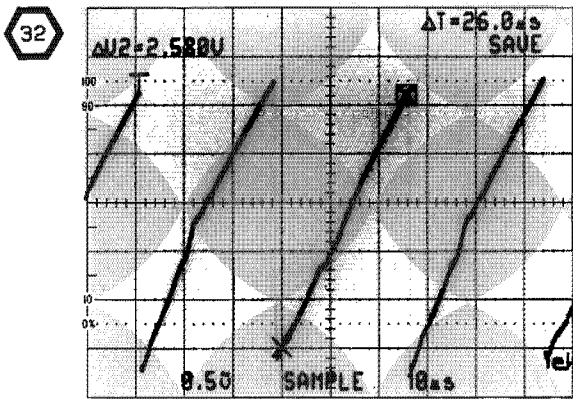
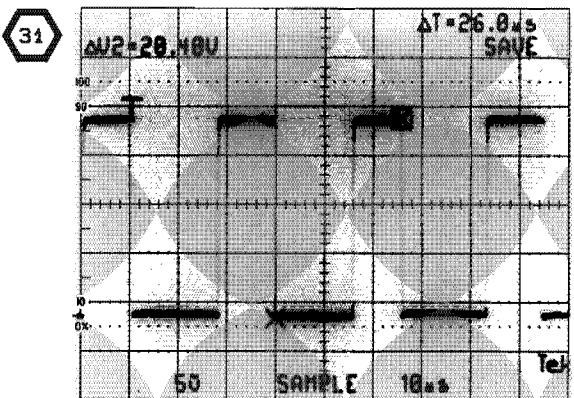
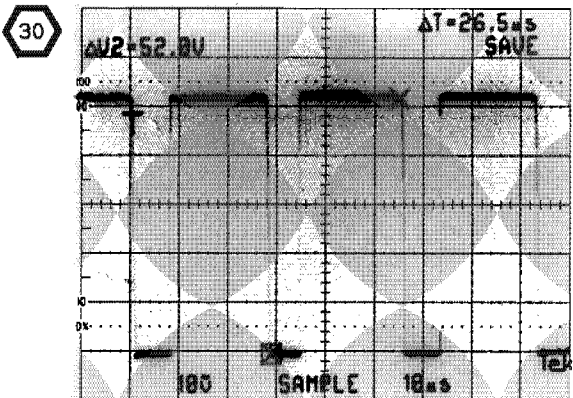
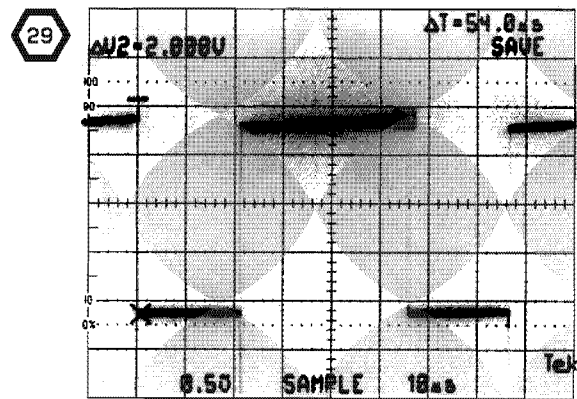
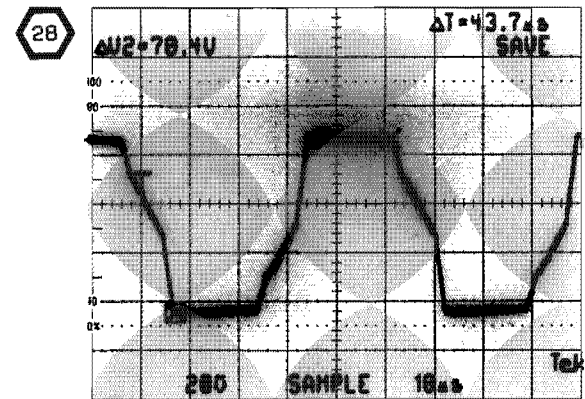
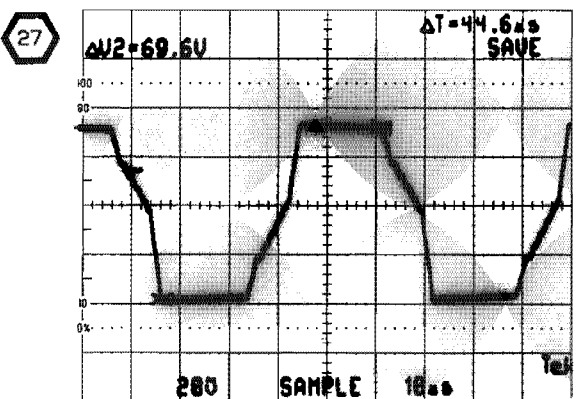
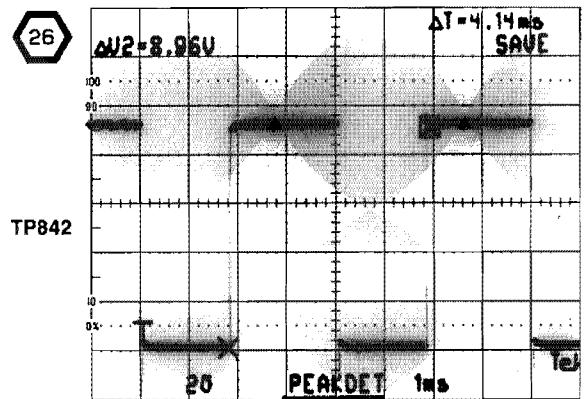
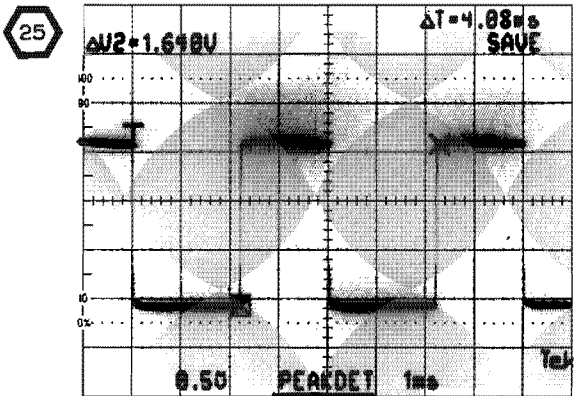
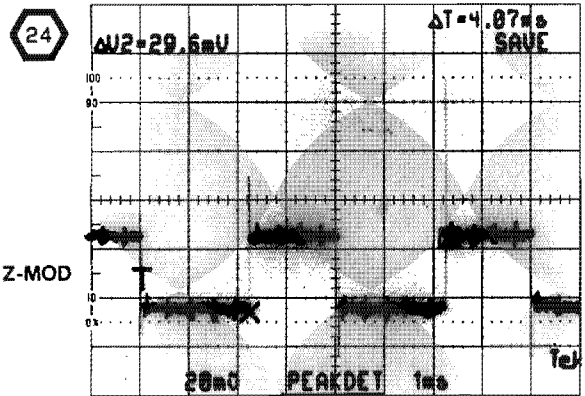




WAVEFORMS FOR DIAGRAM 9

2210 CONTROL SETTINGS

DC VOLTAGES		AC WAVEFORMS	
INTENSITY	MIDRANGE	VERTICAL MODE	CH 1
VERTICAL MODE	CH 1	AC-GND-DC	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		



6848-67

POWER SUPPLY ISOLATION PROCEDURE

Each regulated supply has many feed points to the circuitry throughout the instrument. Diagram 21, Power Distribution, is used along with the schematic diagrams to find a service jumper or other component that may be lifted to isolate the various loads from the power supply.

If a supply comes up after lifting the isolating component, it is very probable that a short exists in the circuitry on that supply line. By lifting jumpers or other components in the supply line

further away from the supply, the circuitry containing the short may be located.

Always set the POWER switch to OFF before soldering or unsoldering service jumpers or other components and before attempting to measure component resistance values.

Specific power supply troubleshooting steps and the resistance values associated with each power supply load are given in the Maintenance section of this manual.

MORE

POWER SUPPLY, Z-AXIS and CRT DIAGRAM 9

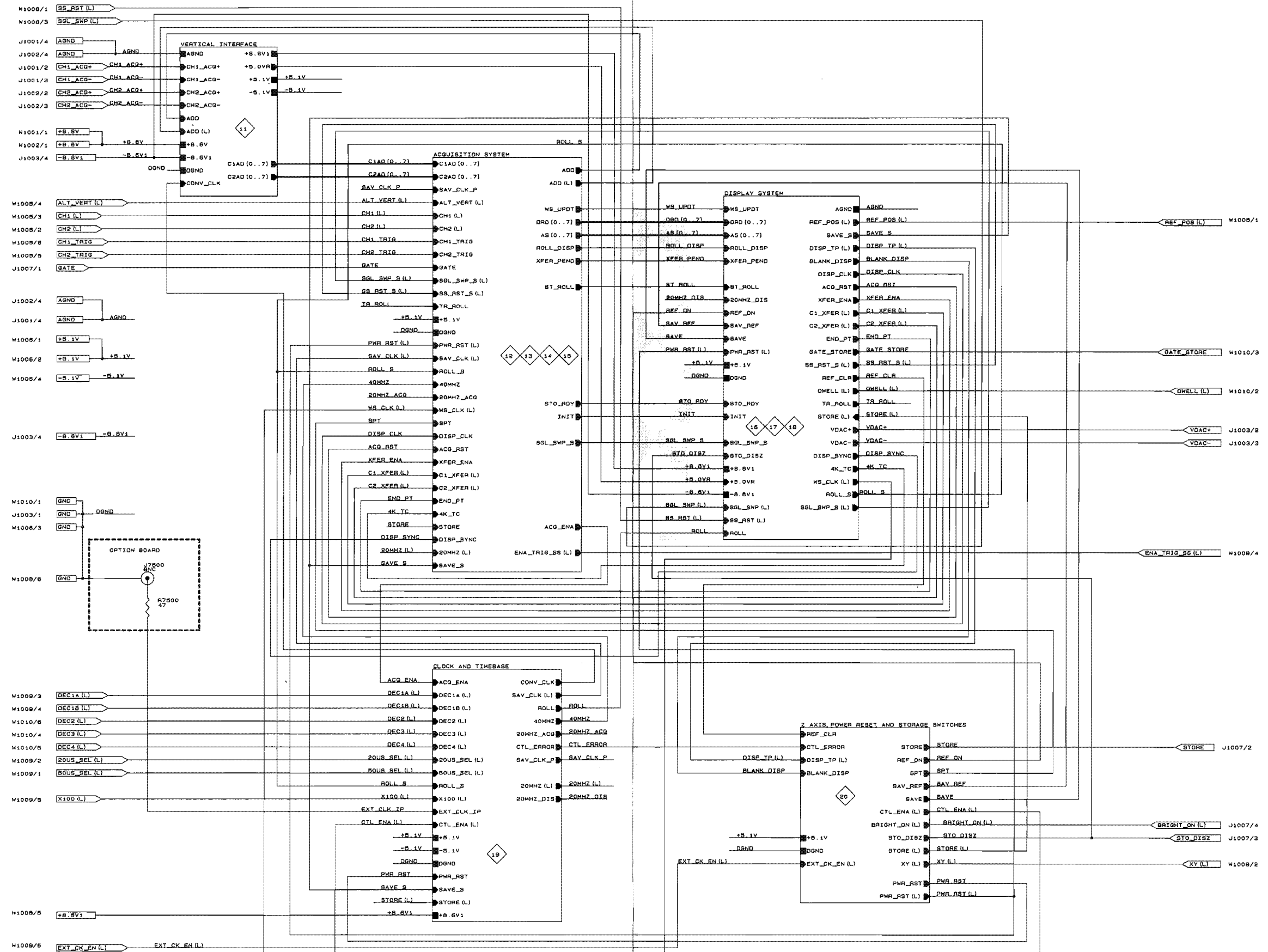
ASSEMBLY A1											
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C805	4H	4F	CR820	2E	4E	R806	4H	4F	R925	7F	7J
C817	1D	3F	CR821	2E	4E	R818	3E	4E	R926	6F	7H
C823	1D	3E	CR822	1D	3E	R819	1E	3F	R927	7F	8H
C824	3E	4E	CR823	1D	3E	R820	2E	4E	R928	7F	8H
C828	3F	3F	CR824	2E	4E	R821	3E	4E	R929	5E	7H
C832	1F	3F	CR825	2E	4E	R822	3D	6B	R930	5E	7H
C834	3F	2F	CR827	2F	3F	R823	3D	4D	R931	6F	8H
C835	3F	2G	CR828	2F	3F	R824	3C	2B	R932	7E	6J
C845	2G	3G	CR840	3G	3G	R825	2E	4E	R933	7F	7H
C846	2G	2G	CR845	2F	2G	R832	2F	3F	R934	8E	5J
C847	2G	2G	CR851	3H	5F	R834	3F	2F	R935	6H	6H
C849	1G	2G	CR853	3H	4F	R835	3F	3F	R936	6H	7H
C851	3H	5F	CR854	2H	4G	R836	3F	3F	R937	5J	6H
C853	4H	6G	CR855	2H	4G	R840	3F	3G	R938	6J	7H
C854	3H	4G	CR912	5D	7J	R841	2F	3G	R939	6J	7H
C855	2H	4G	CR915	7E	6J	R842	2G	3G	R940	6F	7H
C871	2M	5E	CR923	8F	8H	R844	2F	3G	R941	8G	6H
C875	4M	5E	CR933	8F	7J	R845	2F	3G	R942	5G	6H
C893	1K	3G	CR953	5J	7H	R846	2F	2G	R943	6G	6H
C901	4C	5H	CR983	7H	7H	R849	1G	2G	R944	7G	5H
C902	3C	5H	CR984	5K	6G	R850	3H	5F	R945	7G	6H
C908	8D	6J	CR985	6K	6G	R851	3H	6E	R946	7G	5H
C909	6D	5H	CR986	8K	6G	R852	3H	6E	R947	7H	7H
C910	6D	5H	CR987	8L	6G	R853	3H	5G	R952	6J	8E
C912	6D	6J	CR988	8L	6G	R854	3H	4F	R953	5K	7H
C913	7D	6J	CR989	8K	6G	R858	2H	4H	R965	7G	6H
C914	8E	5H	CR990	7K	7F	R860	2H	4H	R966	7H	7H
C915	5C	7J	CR991	7K	7F	R870	2M	5E	R967	7J	6H
C924	7F	7J	CR992	8K	7F	R872	3M	2J	R968	7J	7H
C927	5F	7H	CR993	8K	7F	R873	3M	2J	R969	8J	7H
C932	6H	6H				R874	4M	5E	R975	2J	5G
C933	6J	6H	DS856	2H	4H	R875	4M	6E	R976	2J	4H
C939	6F	7H	DS858	2H	4H	R877	6L	4G	R978	3J	4H
C940	6J	7H	DS870	3J	3H	R885	1F	4F	R982	8K	8G
C941	8G	5H				R886	1H	3F	R983	7K	7H
C942	6G	5H	L910	5E	5J	R888	1J	3G	R993	7N	8F
C952	5J	7H	L970	5E	6G	R889	1J	3G			
C953	5J	6G	L986	7L	6F	R890	1J	3G	T902	8K	7G
C962	8H	8H	L988	8L	6F	R891	1K	3G			
C963	7J	6H	L990	5E	6F	R892	1K	3G	U910	7D	6J
C970	8J	7H	L991	6M	8E	R894	1K	3H	U920A	7F	7J
C971	5F	5G				R898	5D	5H	U920B	6F	7J
C972	5H	6G	Q804	3C	3F	R899	3C	5G	U940	7H	6H
C975	2J	3H	Q817	2D	3E	R900	5B	6H	U975	2J	5F
C976	3J	4J	Q835	3F	2F	R901	5B	5H			
C979	3J	4H	Q840	3G	2G	R907	6C	5H	VR910	6D	5H
C982	7K	7H	Q845	2G	2G	R908	8D	6J	VR931	8F	7H
C983	7J	6H	Q885	1H	4F	R909	6D	5H	VR939	5J	6H
C984	6L	5G	Q911	6D	6H	R910	6D	6H	VR942	5G	6H
C986	8L	5F	Q912	5D	7H	R911	7E	6J	VR969	7J	6H
C987	8L	6F	Q913	5D	6J	R912	6D	6H			
C988	8L	6F	Q918	8D	5J	R913	7D	6J	W90	7M	6E
C989	8L	6F	Q921	6E	8H	R914	7D	6J	W903	4C	5H
C990	7L	6F	Q923	8E	8H	R915	7D	6J	W971	5F	3J
C991	7L	7F	Q930	6J	7H	R918	5D	7J	W972	5F	6F
C992	7L	7F	Q940	6J	7H	R917	8E	5J	W984	5L	5F
C993	7N	8F	Q950	6J	8F	R918	7D	6H	W985	6L	3J
C994	6M	1F	Q960	8J	7H	R919	5D	8J	W987	7M	6F
			Q970	8J	7H	R920	5D	8J	W989	8M	7F
CR816	2E	3E	Q980	8K	8G	R921	6E	8H	W991	7M	7F
CR817	3E	3E				R922	7E	6J	W993	6M	8F
CR818	3E	4E	R804	3C	4F	R923	8F	8H	W1006	6M	7E
CR819	2E	4E	R805	1F	4F	R924	8F	7J	W1007	1B	4F

Partial A1 also shown on diagrams 2, 3, 4, 5, 7 and 8.

MORE ➤

POWER SUPPLY, Z-AXIS and CRT DIAGRAM 9 (CONT)

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
R800 R801	2B 3B	2B 2B	R802 R886	3B 1N	1A 3A	R887	1N	2B			
<i>Partial A1 also shown on diagrams 2, 3, 4, 5, 7 and 9.</i>											
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 C903 C904 C905	5C 7B 7B 7B	2C 3C 3D 3B	CR904 FS901 J902	6B 8B 5A	1C 1B 2B	L902 P901 Q900	8B 8B 5B	2B 2A 1D	R903 R904 R905 R906	5B 4B 5B 5B	1D 1D 1D 1D
CR901 CR902 CR903	5B 5B 6B	1C 1C 1C	L901	8B	3B	R902	4B	1D	S901 S902	7B 6B	3C 3A
ASSEMBLY A5											
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R893	1L	1A	W893	1L	1A						
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
J1006	5M	7J	J1007	1C	7D						
<i>Partial A10 also shown on diagrams 2, 5, 6, 11, 13, 14, 15, 17, 18, 19 and 20.</i>											
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	7N	CHASSIS	P900	3L	CHASSIS	T901	6A	CHASSIS	V900	3L	CHASSIS



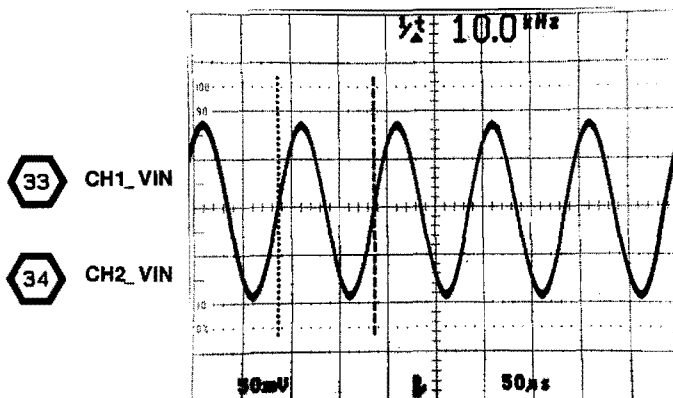
VERTICAL INTERFACE DIAGRAM 11

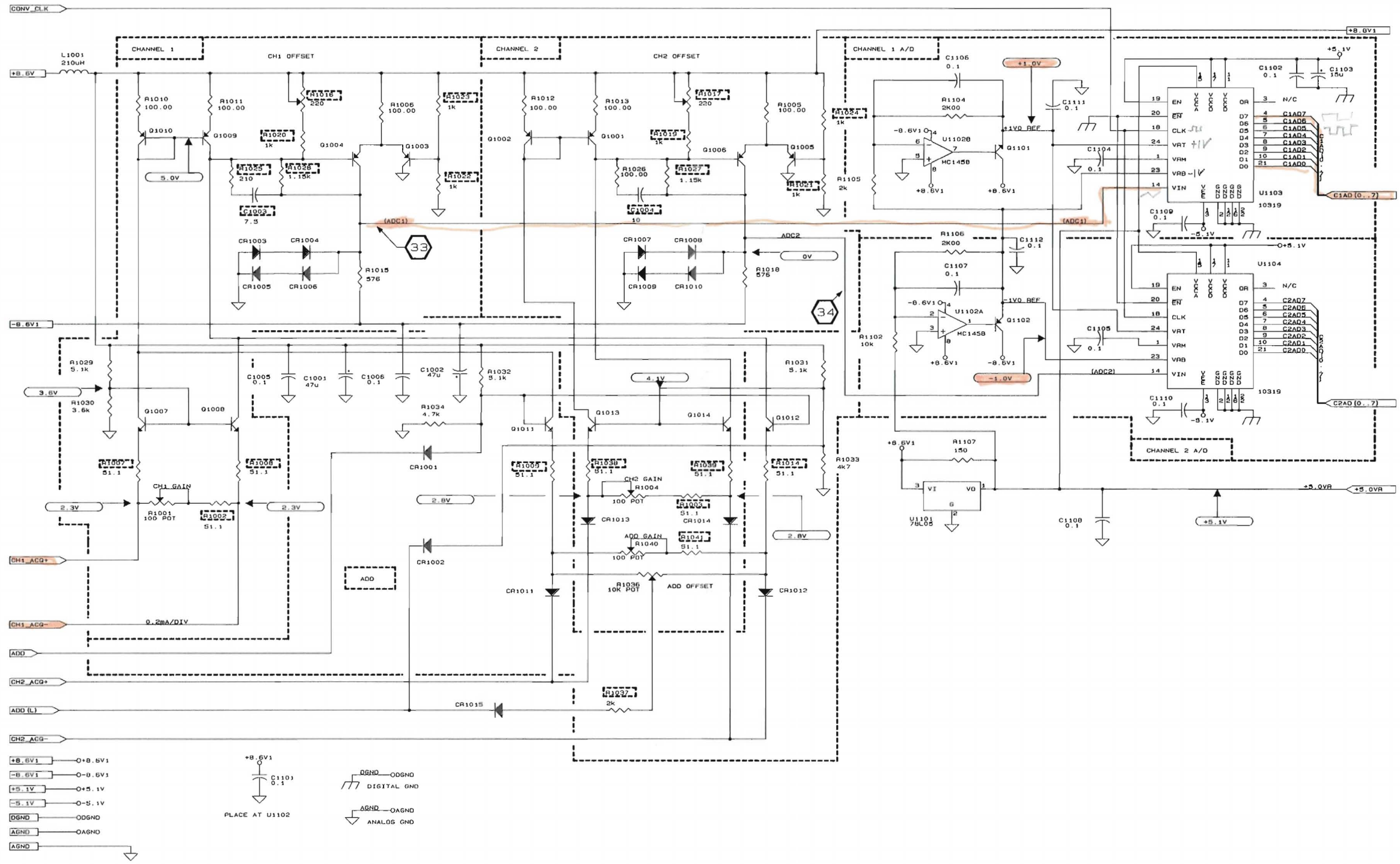
ASSEMBLY A10											
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1001	4C	6A	CR1009	4F	6B	R1001	6B	5A	R1026	3F	6B
C1002	4D	6B	CR1010	4F	6B	R1002	6C	4A	R1027	3F	6B
C1003	3C	5B	CR1011	6E	5A	R1003	5F	6A	R1028	3C	5B
C1004	3F	6B	CR1012	6G	5A	R1004	5F	6A	R1029	4A	5B
C1005	4C	4B	CR1013	6F	6A	R1005	2G	6B	R1030	5B	5B
C1006	4D	6B	CR1014	6G	5A	R1006	2D	5B	R1031	4G	6B
C1101	8C	4A	CR1015	7E	5B	R1007	5B	5A	R1032	4E	5B
C1102	2L	2B				R1008	5C	5A	R1033	5H	6B
C1103	2M	4C	L1001	2A	6A	R1009	5E	5B	R1034	5D	5B
C1104	3K	4B				R1010	2B	5B	R1036	6F	5A
C1105	4K	3B	Q1001	2F	6B	R1011	2C	5B	R1037	7F	5B
C1106	2J	3A	Q1002	2E	6B	R1012	2E	6B	R1038	5F	6B
C1107	4J	4A	Q1003	3D	5B	R1013	2F	6B	R1039	5G	6B
C1108	6K	2A	Q1004	3C	5B	R1013	4G	6B	R1040	6F	5A
C1109	3K	3A	Q1005	3G	6B	R1014	5G	5B	R1041	6F	5A
C1110	5K	2A	Q1006	3G	6B	R1015	4D	4B	R1102	4H	2A
C1111	2J	3A	Q1007	5B	5A	R1016	2C	4A	R1104	2J	3A
C1112	3J	4A	Q1008	5C	5A	R1017	2G	6A	R1105	3H	3A
			Q1009	2C	5B	R1018	4G	6B	R1106	3J	4A
CR1001	5D	6B	Q1010	2B	5B	R1019	2F	6B	R1107	5J	2A
CR1002	6D	5B	Q1011	5E	5B	R1020	2C	4A			
CR1003	3C	5B	Q1012	5G	5B	R1021	3G	6B	U1101	6H	3A
CR1004	3C	5B	Q1013	5F	6B	R1022	3D	5B	U1102A	4J	4A
CR1005	4C	5B	Q1014	5G	6B	R1023	2D	5B	U1102B	2J	4A
CR1006	4C	5B	Q1101	3J	3A	R1024	2H	6B	U1103	3L	4B
CR1007	3F	6B	Q1102	4J	4A	R1025	3C	5B	U1104	4L	3B
CR1008	3F	6B									

Partial A10 also shown on diagrams 2, 5, 6, 9, 13, 14, 15, 17, 18, 19 and 20.

WAVEFORMS FOR DIAGRAM 11

Apply a 1-division p-p sine-wave signal of 10 kHz to the CH 1 and CH 2 inputs. CH 1 and CH 2 VOLT/DIV settings at 0.1 V. Use BW LIMIT on the test oscilloscope to reduce noise.



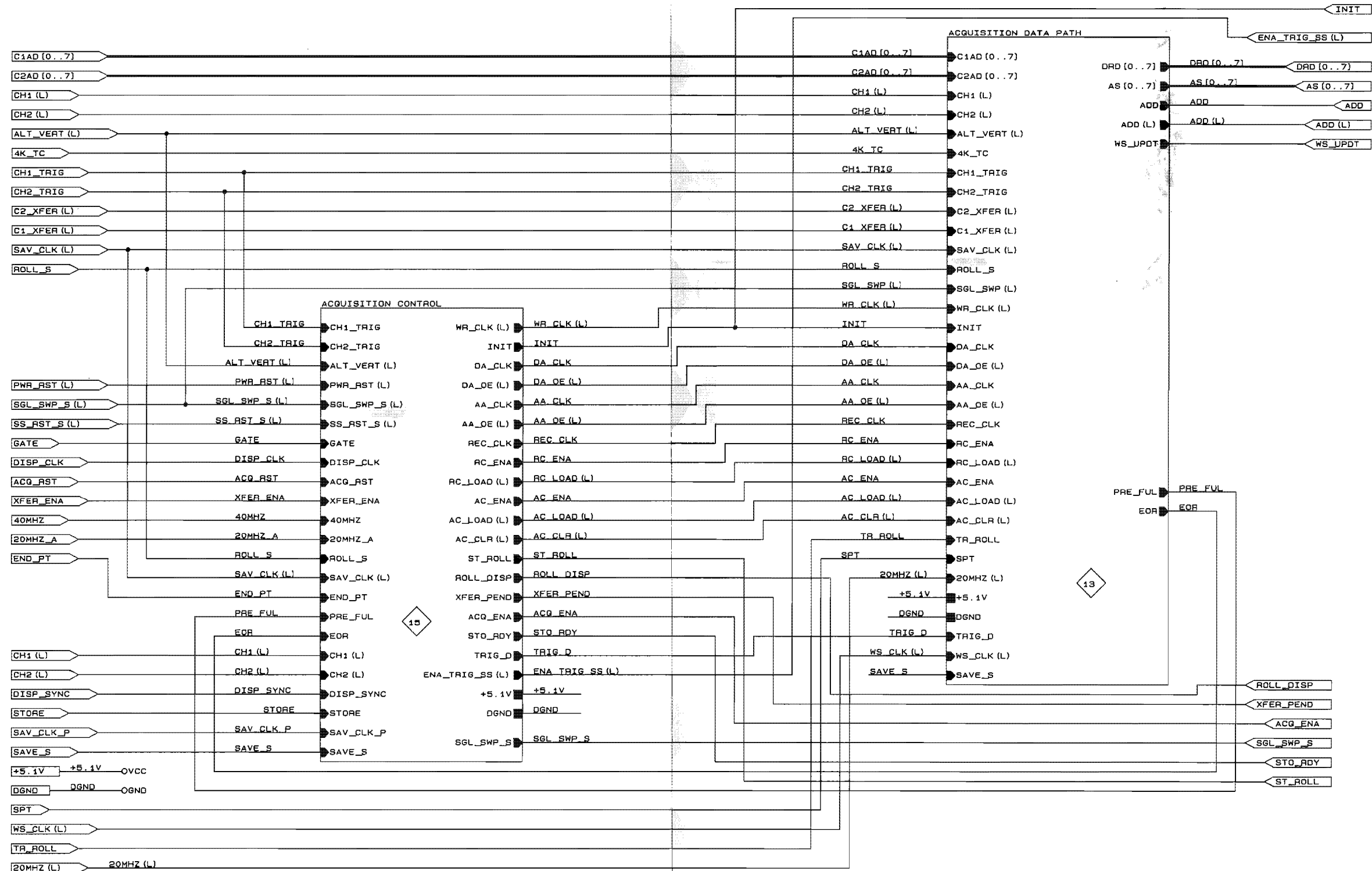


11

 **Static Sensitive Devices**
See Maintenance Section

12

ACQUISITION SYSTEM
INTERCONNECT



12

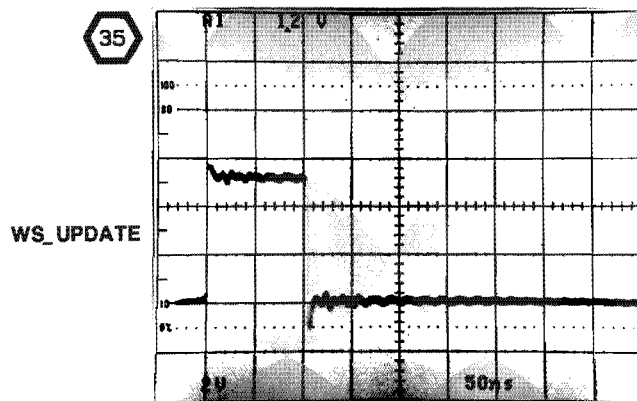
ACQUISITION DATA PATH DIAGRAM 13

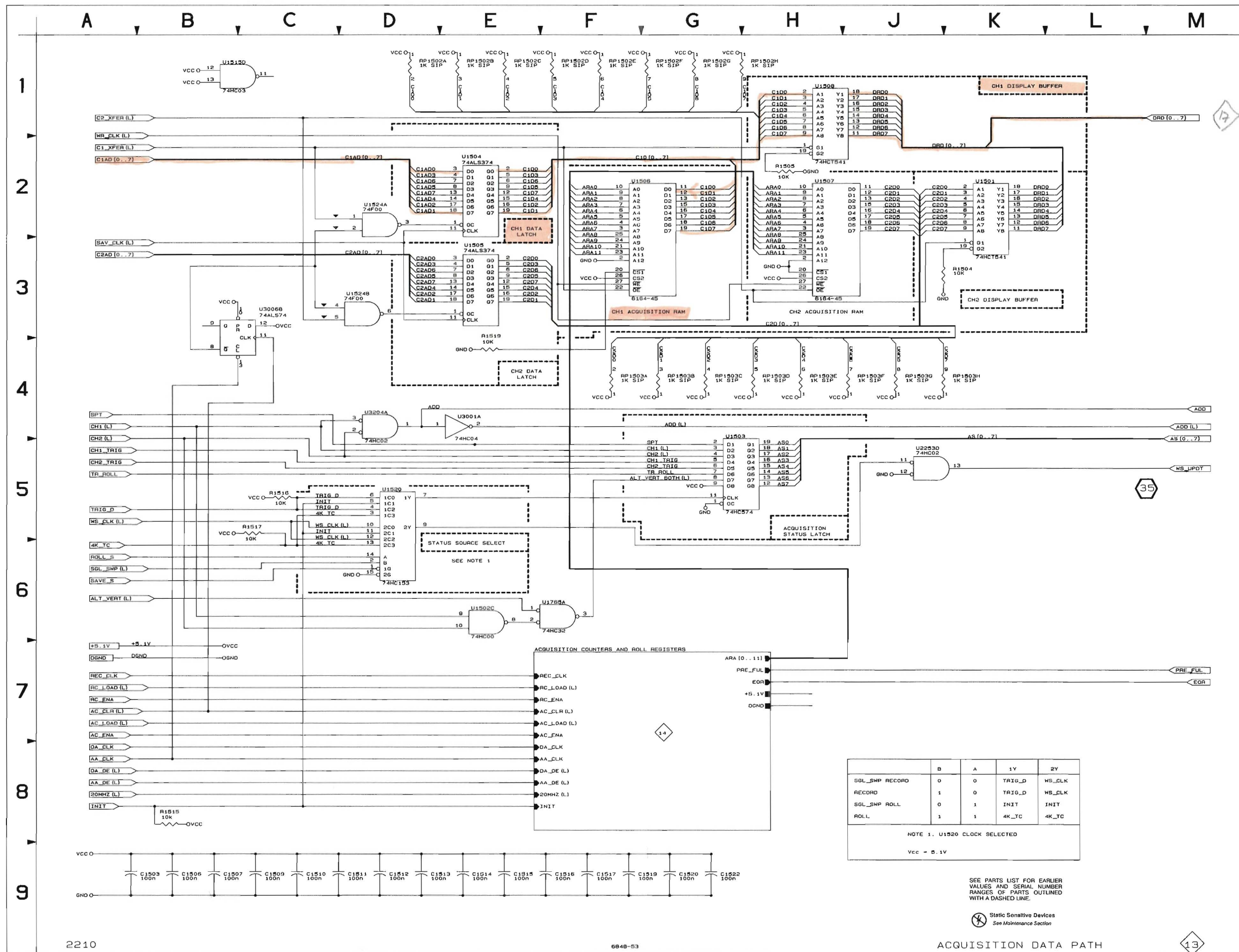
ASSEMBLY A10											
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C1503	8B	6E	R1504	3K	3C	RP1502H	1H	4C	U1505	3E	3C
C1506	8B	3C	R1505	2H	3C	RP1503A	4F	3C	U1506	2G	4C
C1507	9C	2D	R1515	8B	5F	RP1503B	4G	3C	U1507	2H	3C
C1509	9C	1F	R1516	5C	6D	RP1503C	4G	3C	U1508	1H	4C
C1510	9C	3E	R1517	5C	6C	RP1503D	4H	3C	U1515D	1B	4D
C1511	9D	3E	R1519	3E	3C	RP1503E	4H	3C	U1520	5D	5D
C1512	9D	1E				RP1503F	4J	3C	U1524A	2D	4C
C1513	9E	4E	RP1502A	2D	4C	RP1503G	4J	3C	U1524B	3D	4C
C1514	9E	2E	RP1502B	1E	4C	RP1503H	4K	3C	U1765A	6F	7F
C1515	9E	4E	RP1502C	1E	4C				U2253D	5J	6D
C1516	9F	1E	RP1502D	1F	4C	U1501	2K	3C	U3001A	4E	4H
C1517	9F	3D	RP1502E	1F	4C	U1502C	6E	6G	U3006B	3C	3G
C1519	9G	2E	RP1502F	1G	4C	U1503	4G	7E	U3204A	4D	6F
C1520	9G	5D	RP1502G	1G	4C	U1504	2E	4C			
C1522	9G	5D									

Partial A10 also shown on diagrams 2, 5, 6, 9, 11, 14, 15, 17, 18, 19 and 20.

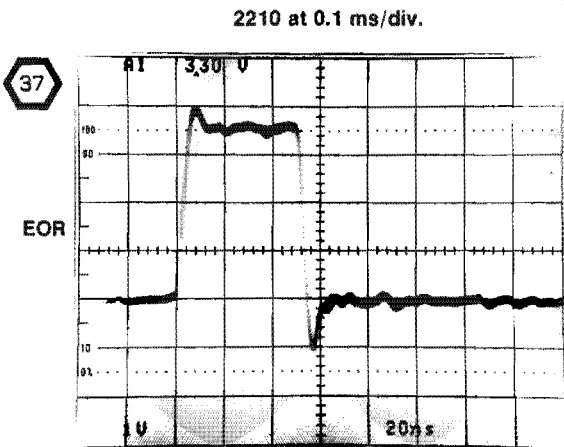
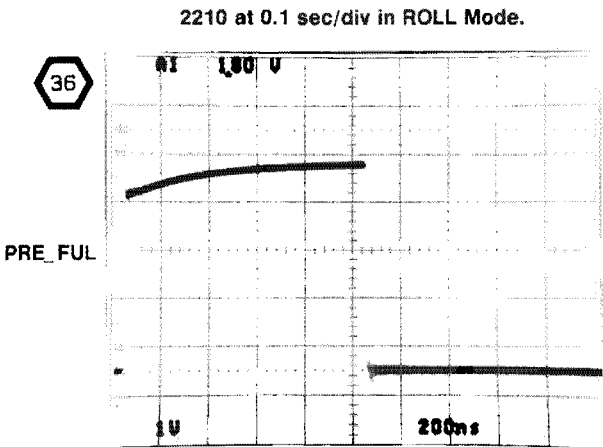
WAVEFORM FOR DIAGRAM 13

2210 at 0.1 ms/div.





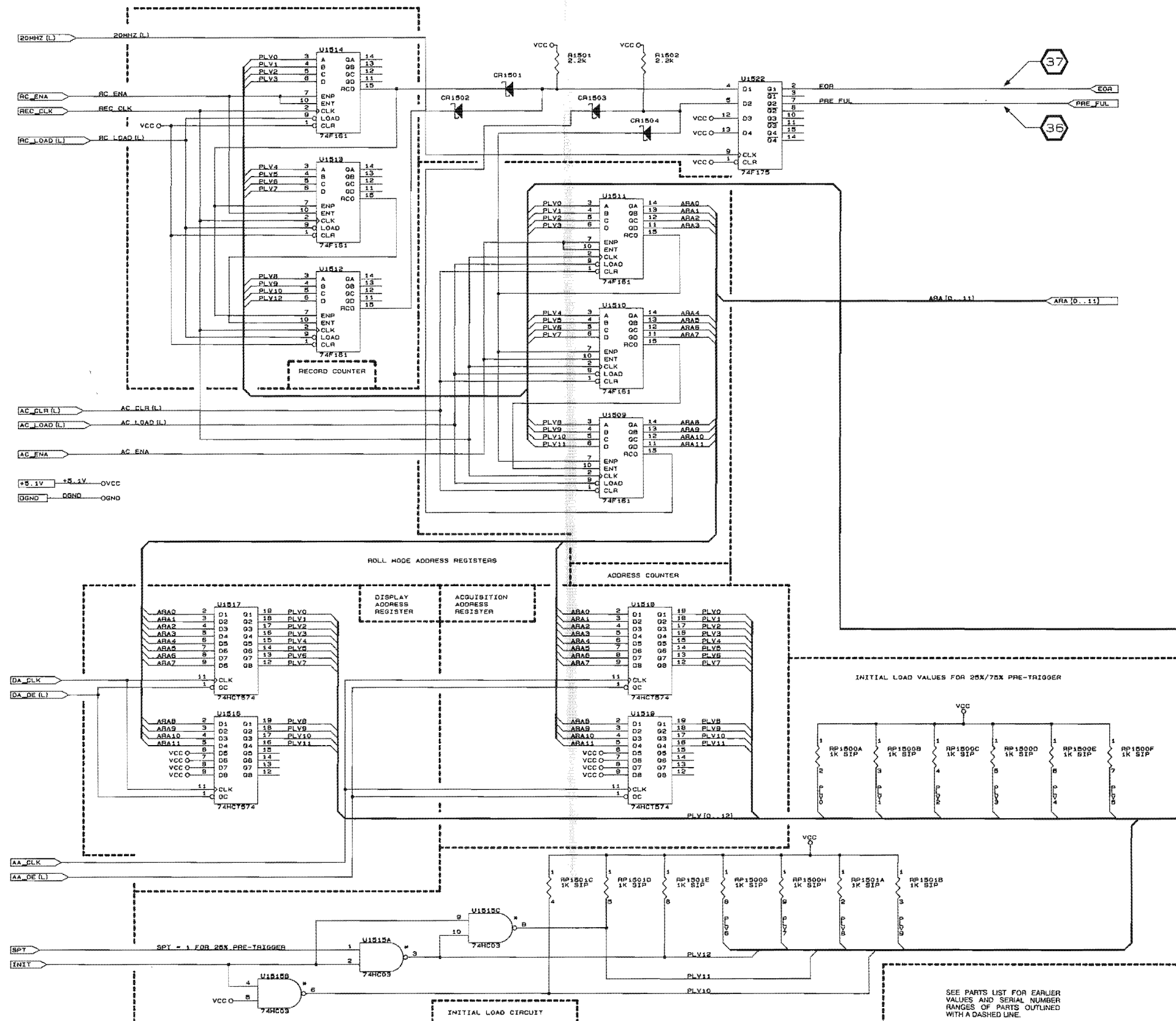
WAVEFORMS FOR DIAGRAM 14



ACQUISITION COUNTERS AND ROLL REGISTERS DIAGRAM 14

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	1F	1F	RP1500C	7K	2E	RP1501D	8G	1D	U1515A	8E	4D
CR1502	2F	1E	RP1500D	7K	2E	RP1501E	8H	1D	U1515B	9D	4D
CR1503	2G	1F	RP1500E	7L	2E				U1515C	8F	4D
CR1504	2G	1F	RP1500F	7L	2E	U1509	4G	2E	U1515	7D	4D
			RP1500G	8H	2E	U1510	3G	3E	U1516	7D	2D
R1501	1G	1G	RP1500H	8H	2E	U1511	2G	3E	U1517	6D	3D
R1502	1G	1G	RP1501A	8J	1D	U1512	3E	1E	U1518	6G	3D
			RP1501B	8J	1D	U1513	2E	4E	U1519	7G	2D
RP1500A	7J	2E	RP1501C	8G	1D	U1514	1E	2E	U1522	1H	1G
RP1500B	7J	2E									

Partial A10 also shown on diagrams 2, 5, 6, 9, 11, 13, 15, 17, 18, 19 and 20.



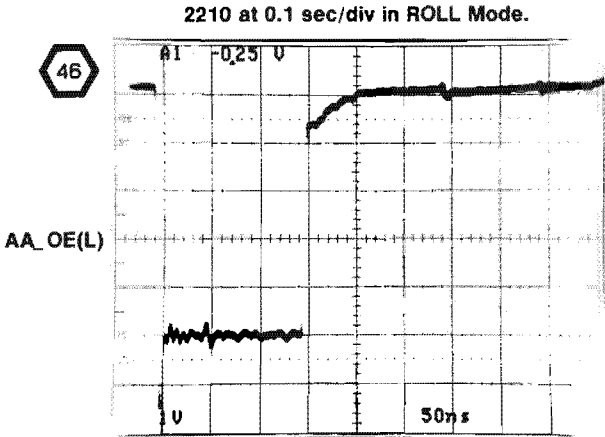
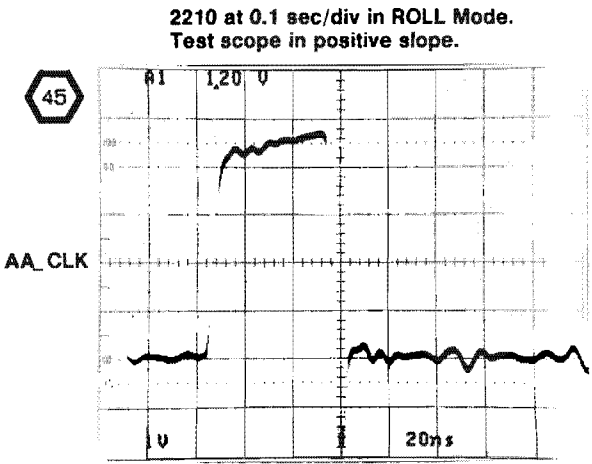
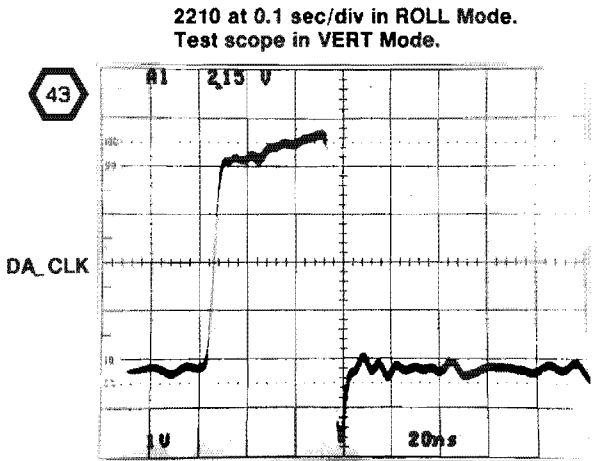
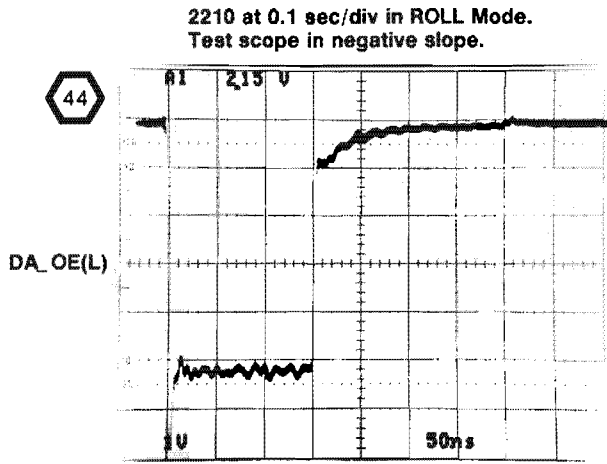
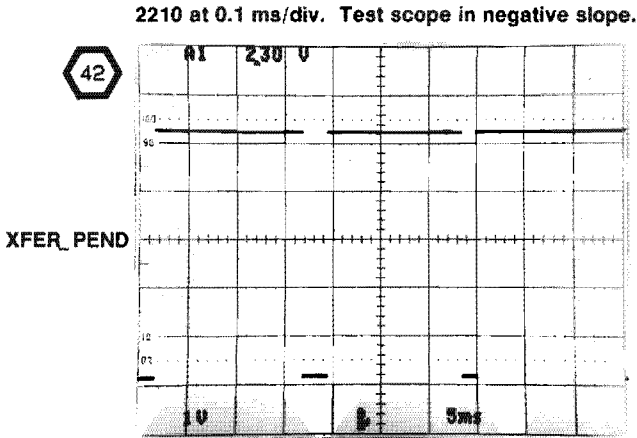
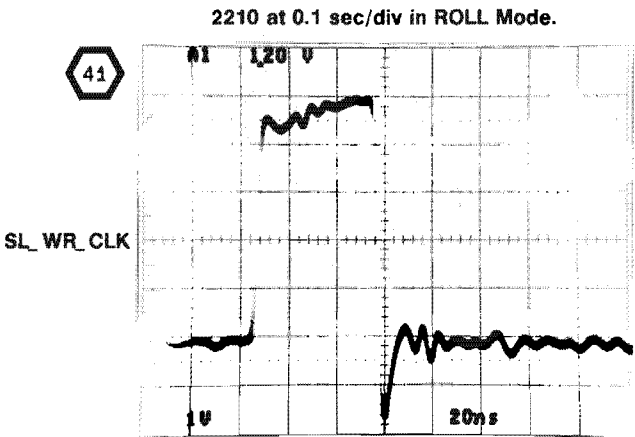
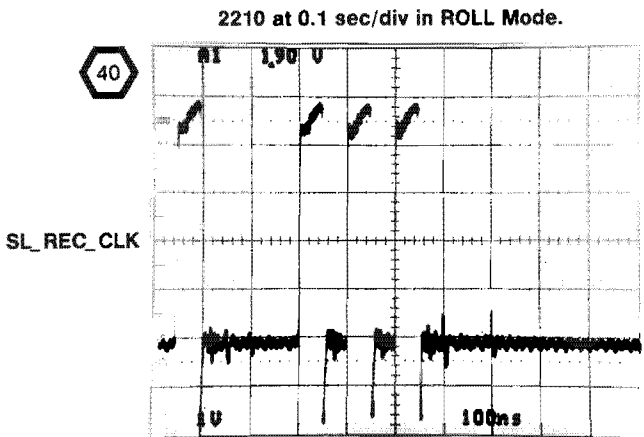
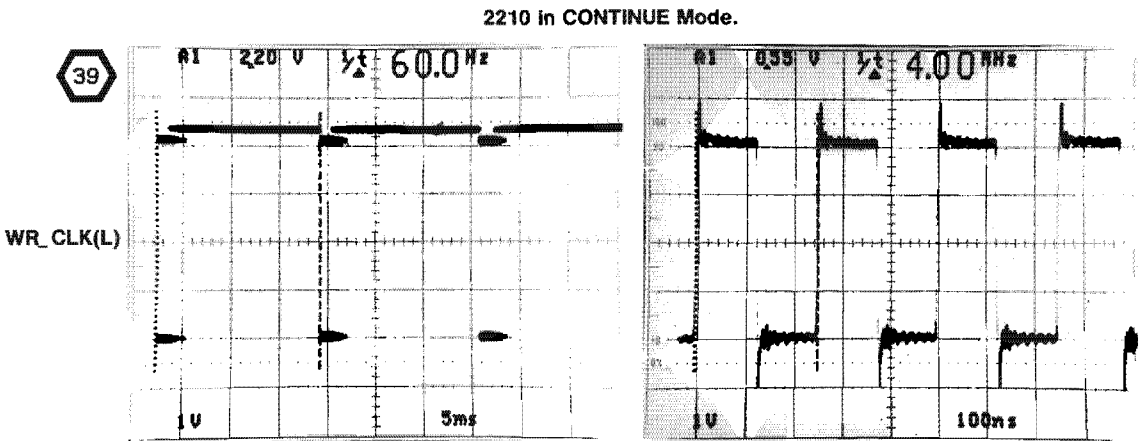
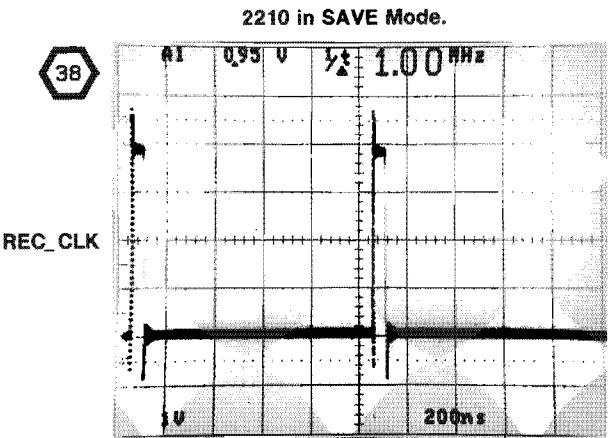
SEE PARTS LIST FOR EARLIER
VALUES AND SERIAL NUMBER
RANGES OF PARTS OUTLINED
WITH A DASHED LINE.

Static Sensitive Devices
See Maintenance Section

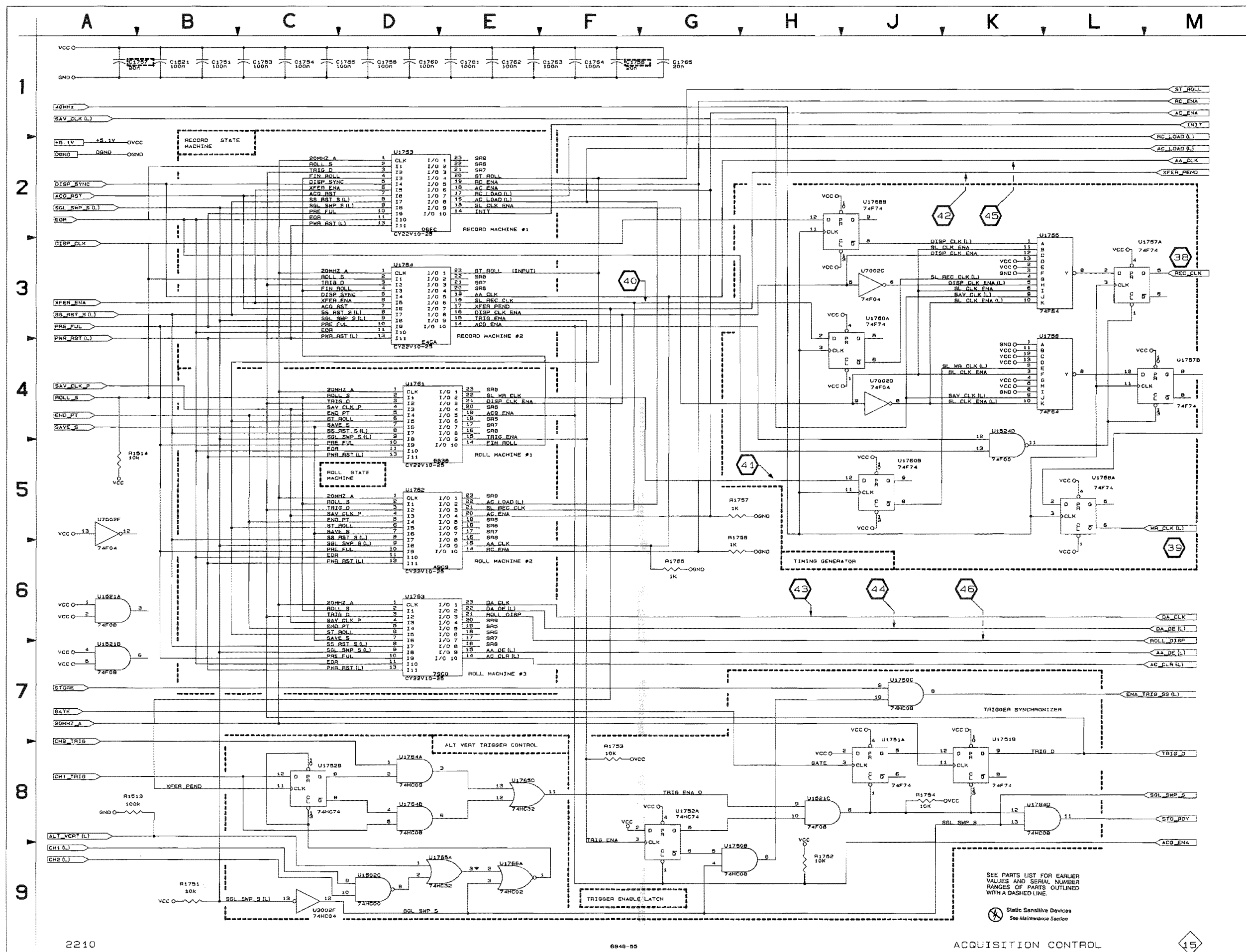
ACQUISITION COUNTERS
AND ROLL REGISTERS

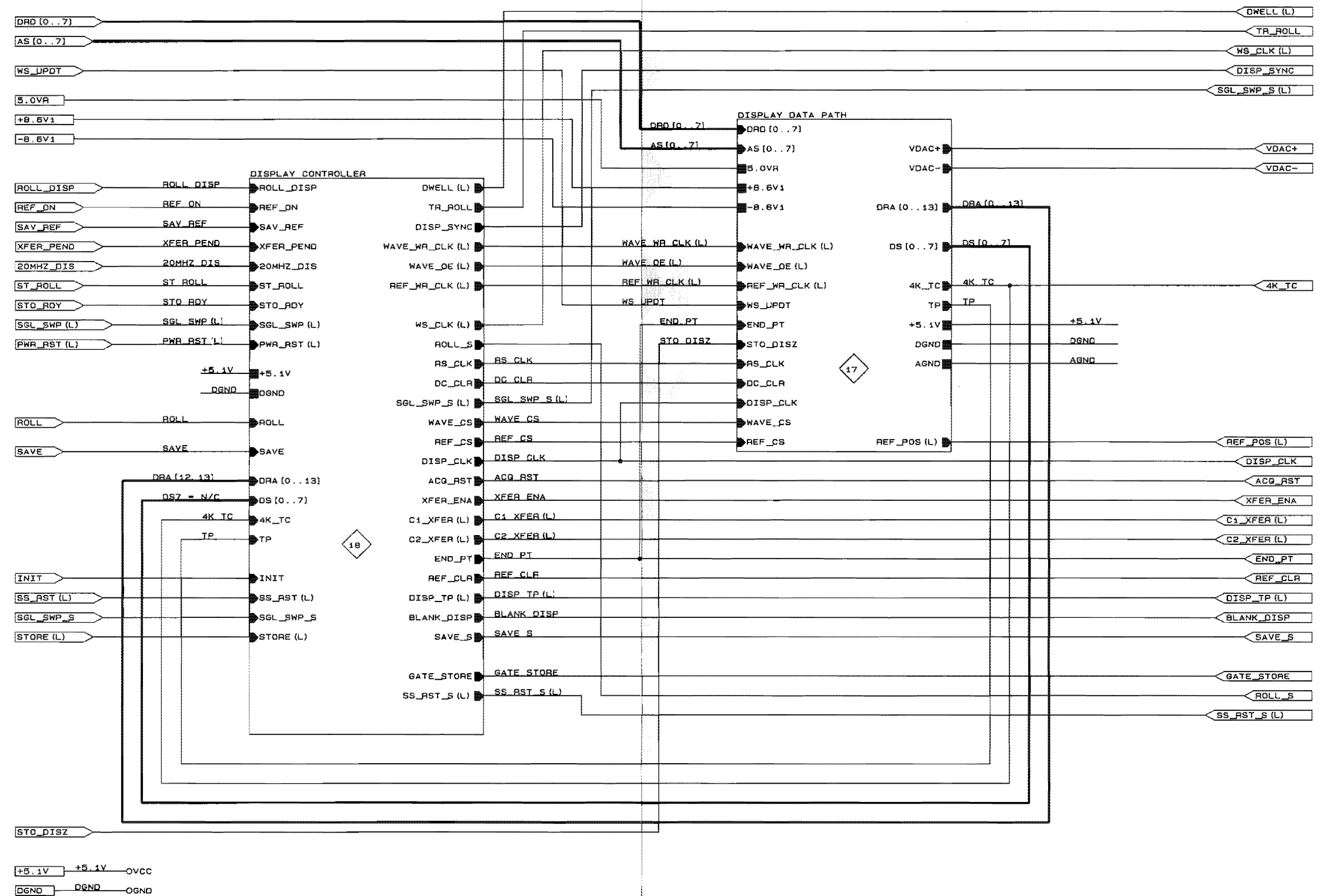
14

WAVEFORMS FOR DIAGRAM 15



Partial A10 also shown on diagrams 2, 5, 6, 9, 11, 13, 14, 17, 18, 19 and 20.





DISPLAY DATA PATH DIAGRAM 17

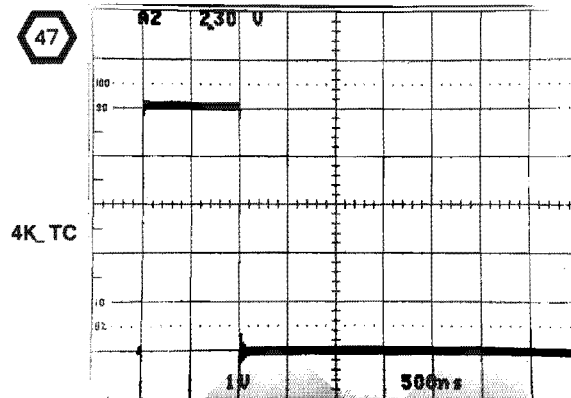
ASSEMBLY A10											
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C2001	8B	5D	P2007	4G	6C	R2505	5M	7A	U2002	8C	6E
C2002	8B	6E				R2508	5L	7B	U2003	6E	6E
C2003	8C	5E	Q2501	5M	7B	R2507	6M	6B	U2004A	5C	7G
C2007	8C	6C	Q2502	5L	7B	R2508	6J	7B	U2005	4D	6C
C2500	3J	7C				R2509	5H	6A	U2006	3D	5C
C2501	5K	6C	R2001	3A	5D	R2510	5H	6C	U2007	4F	6C
C2503	3K	7B	R2002	5F	6C	R2511	4K	7B	U2501	4J	7C
C2505	4J	6C	R2003	6D	5D	R2513	6K	6A	U2502A	4L	7B
C2506	5K	7C	R2501	3J	7C	R2516	7K	7B	U2502B	7K	7B
C2507	3H	6B	R2502	5H	6C						
C2510	7K	7B	R2503	5K	7C	U2001	3B	5D	W2500	5L	7B

Partial A10 also shown on diagrams 2, 5, 6, 9, 11, 13, 14, 15, 18, 19 and 20.

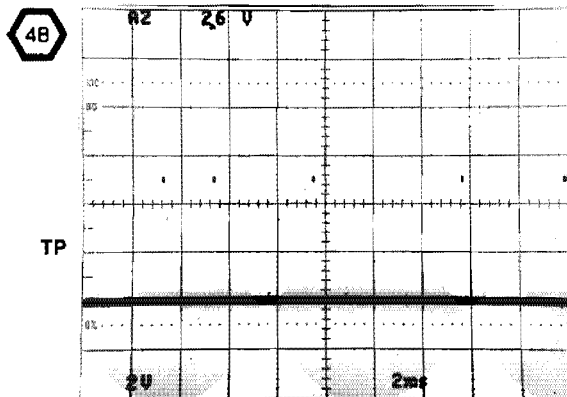
WAVEFORMS FOR DIAGRAM 17

U2261

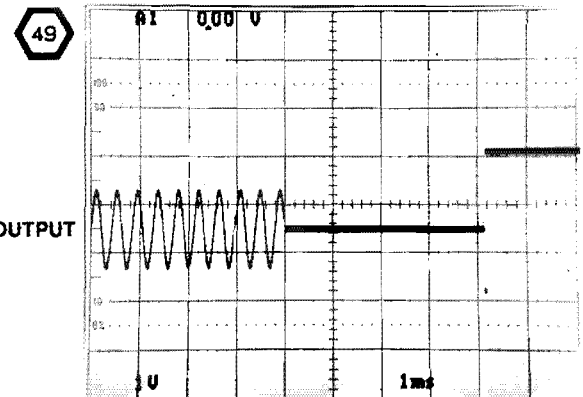
2210 at 0.1 ms/div. Trigger test scope on BLKO (U2661, pin 10).



2210 at 0.1 ms/div. Trigger test scope on BLKO (U2661, pin 10).



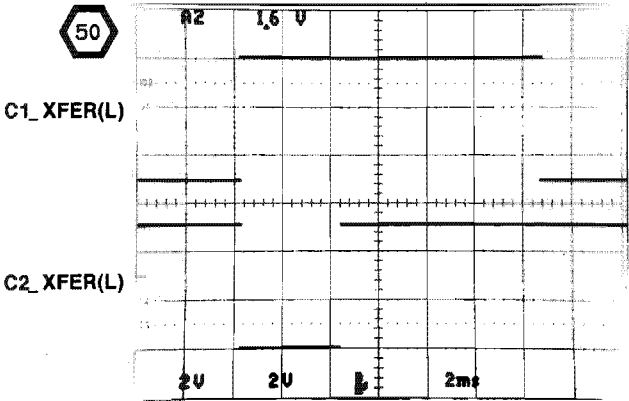
Apply a 5 div p-p sine-wave signal at 10 kHz to the CH 1 input. 2210 at 0.1 ms/div.



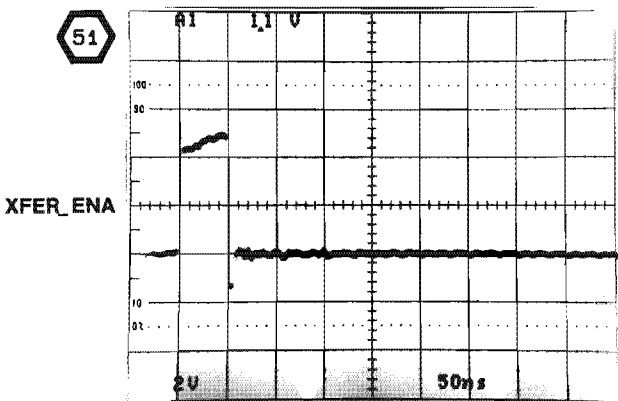


WAVEFORMS FOR DIAGRAM 18

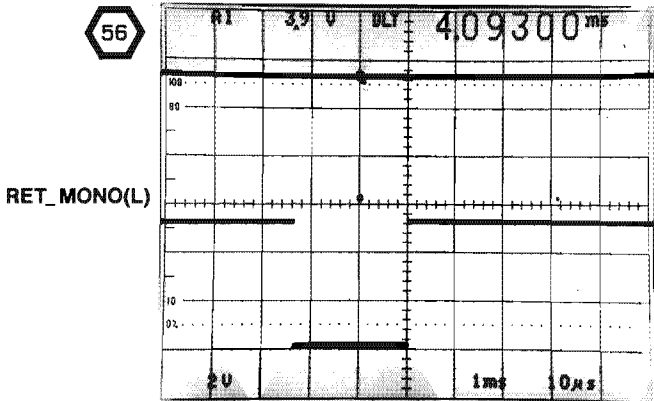
2210 at 0.1 ms/div. Test scope set to display CH 1 and CH 2 in Alternate mode. Trigger test scope on the CH 1 signal.



2210 at 0.1 ms/div.

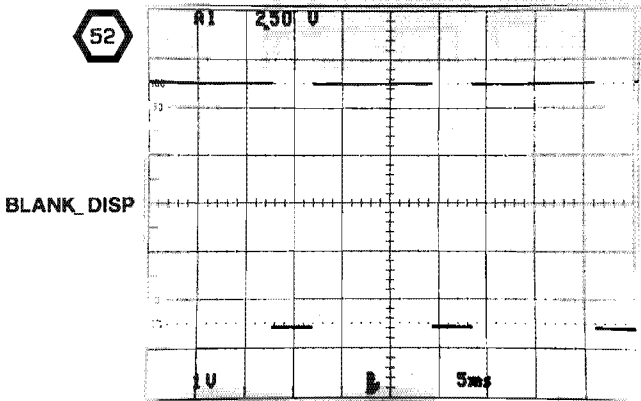


2210 at 0.1 ms/div. Test scope in ALT Horiz Display with B Sweep expanded.

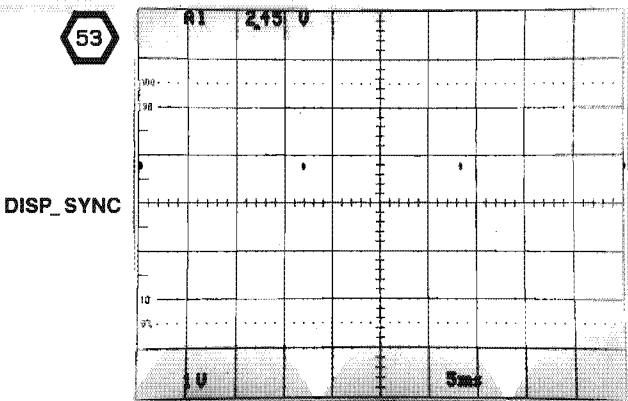


6848-74

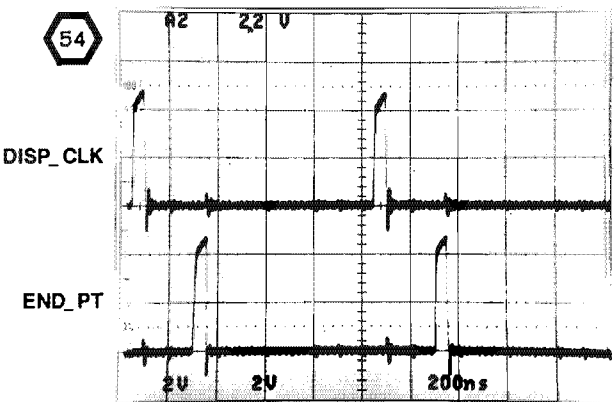
2210 at 0.1 ms/div. REFERENCE Display OFF.



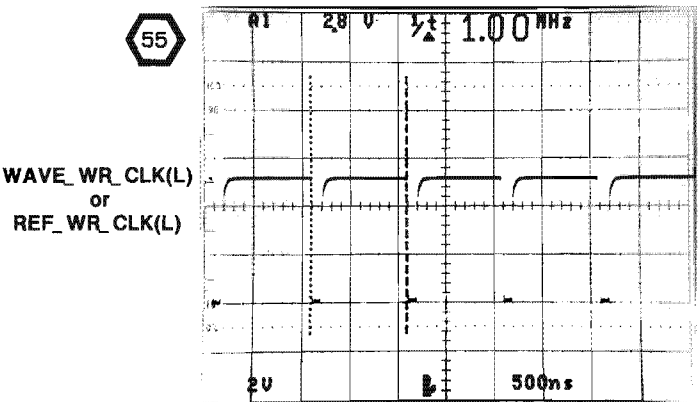
2210 at 0.1 ms/div.



2210 at 0.1 ms/div. Trigger test scope on DISP_CLK.



NOTE: REF_WR_CLK on pin 21 is a single burst with each SAVE REF operation.



MORE ➡

WAVEFORMS FOR DIAGRAM 18

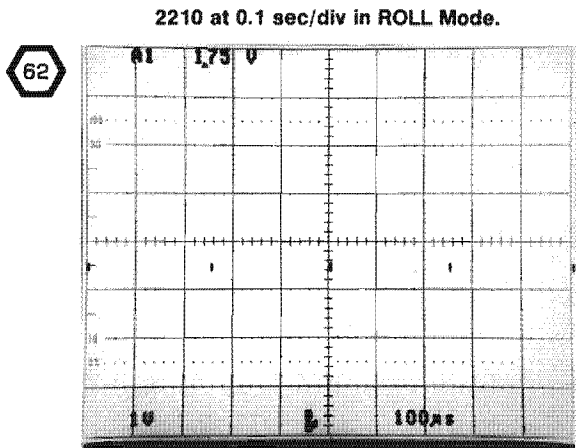
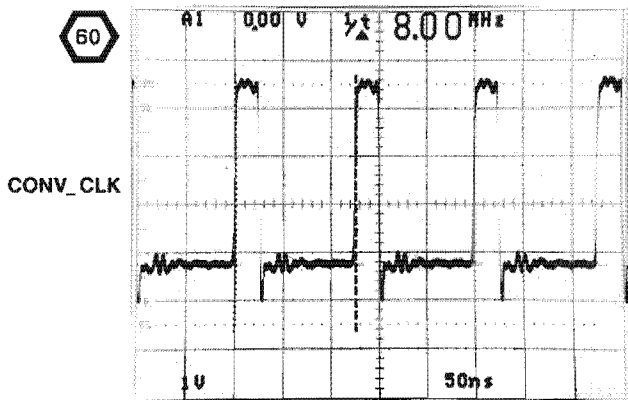
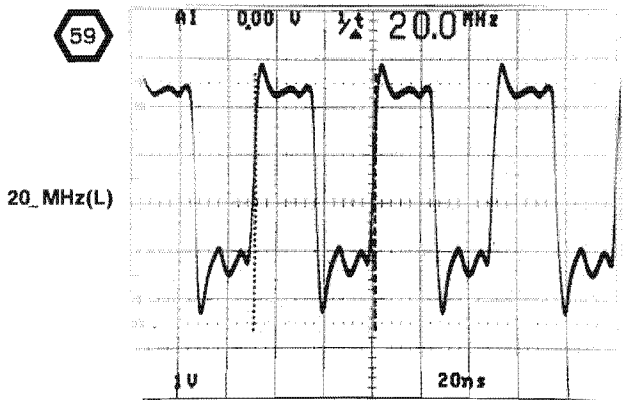
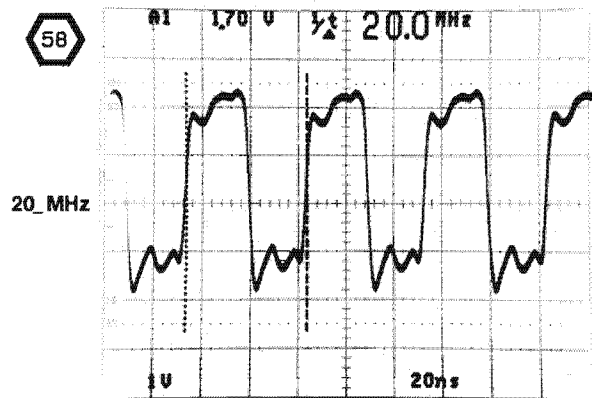
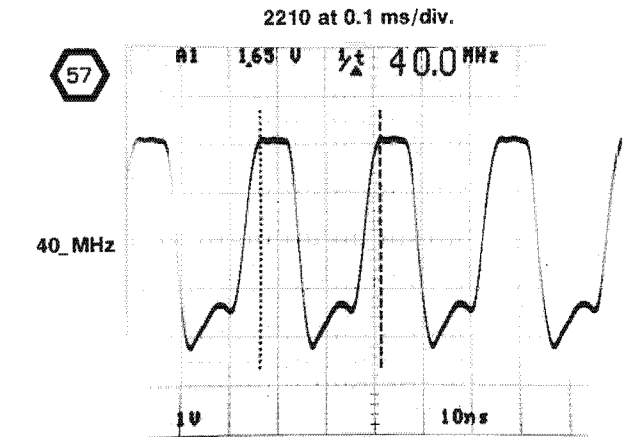
DISPLAY CONTROLLER DIAGRAM 18

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
C2008	9G	6D	R2259	7F	7F	U1524C	8G	4C	U2253B	8L	6D
C2250	6F	4G	R2261	3K	6G	U1750A	3B	6F	U2253C	8E	6D
C2251	6B	4G	R2262	4K	1E	U1750D	7L	6F	U2254A	6H	5F
C2256	9H	4E				U1764C	2J	6F	U2254B	7J	5F
C2259	9H	4D	RP2200A	6B	4G	U1765B	2B	7F	U2255D	5J	7D
C2261	9J	5E	RP2200B	6E	4G	U1765B	5L	7F	U2256A	4C	4E
C2262	9J	4F	RP2200C	6G	4G	U1765C	2K	7F	U2256B	8K	4E
			RP2200D	6H	4G	U1766C	2K	5F	U2257A	6F	4G
R2200	4F	4F	RP2200E	7E	4G	U1766D	1K	5F	U2257B	6C	4G
R2250	6E	4G	RP2200F	5B	4G	U2008	7B	6D	U2258A	5B	5G
R2251	6B	4H	RP2200G	1H	4G	U2251A	4L	5E	U2258B	7K	5G
R2252	6G	6C	RP2200H	1K	4G	U2251B	7H	5E	U2259	3J	4D
R2253	3H	2F				U2251C	4H	5E	U2261	1F	5E
R2254	1J	4E	U1500	9C	4F	U2251D	1D	5E	U2262	2F	4F
R2255	2H	4F	U1502A	1C	6G	U2253A	5L	6D	U3204D	2B	6F
R2258	7F	4E	U1502D	2K	6G						

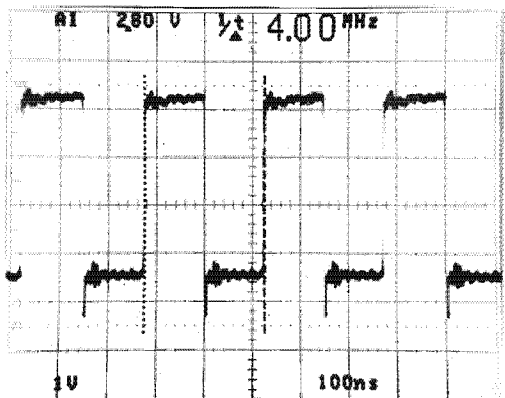
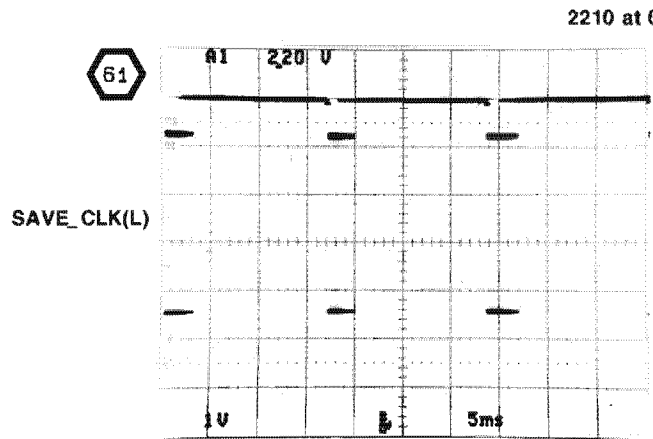
Partial A10 also shown on diagrams 2, 5, 6, 9, 11, 13, 14, 15, 17, 19 and 20.



WAVEFORMS FOR DIAGRAM 19



6848-75



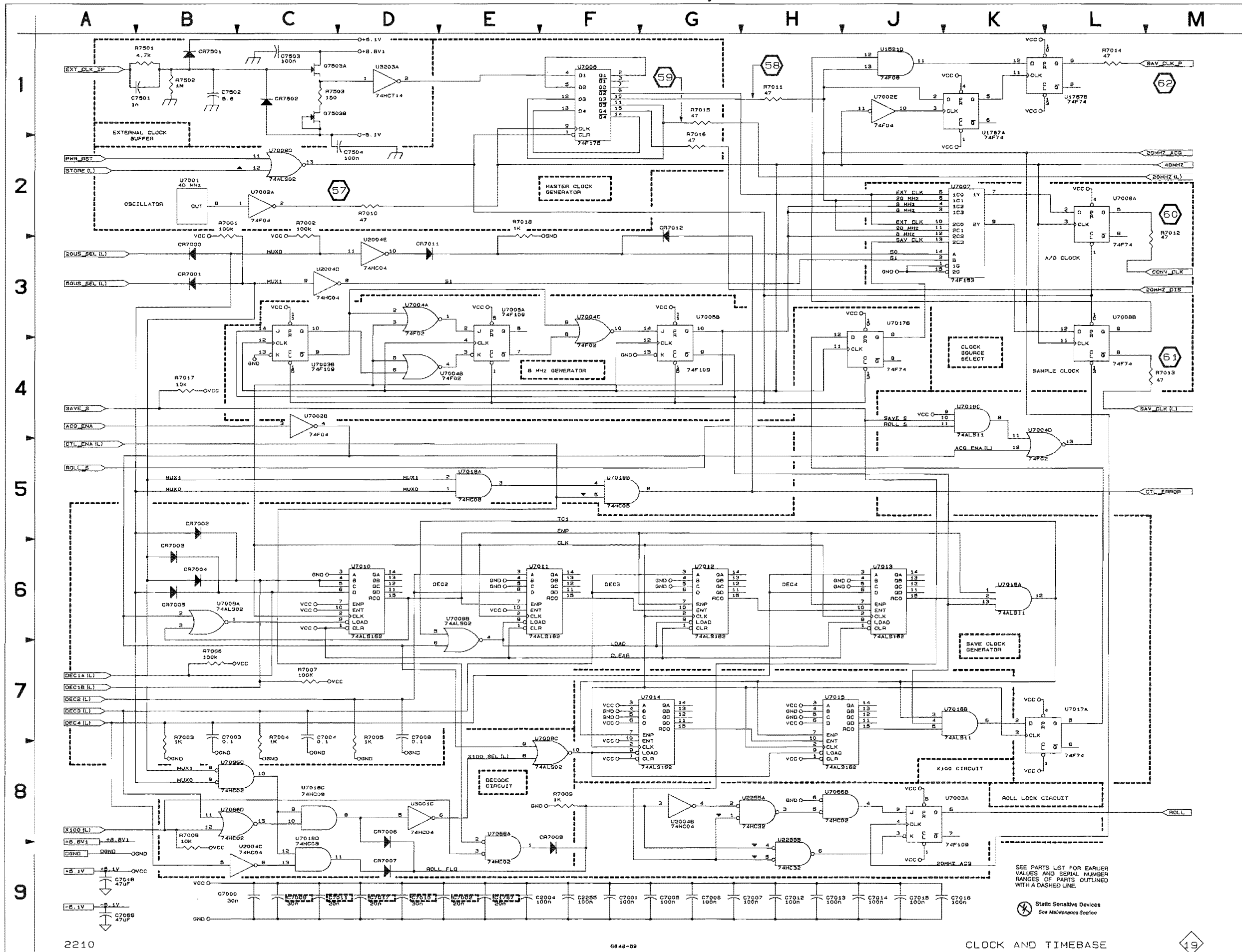
MORE

WAVEFORMS FOR DIAGRAM 19

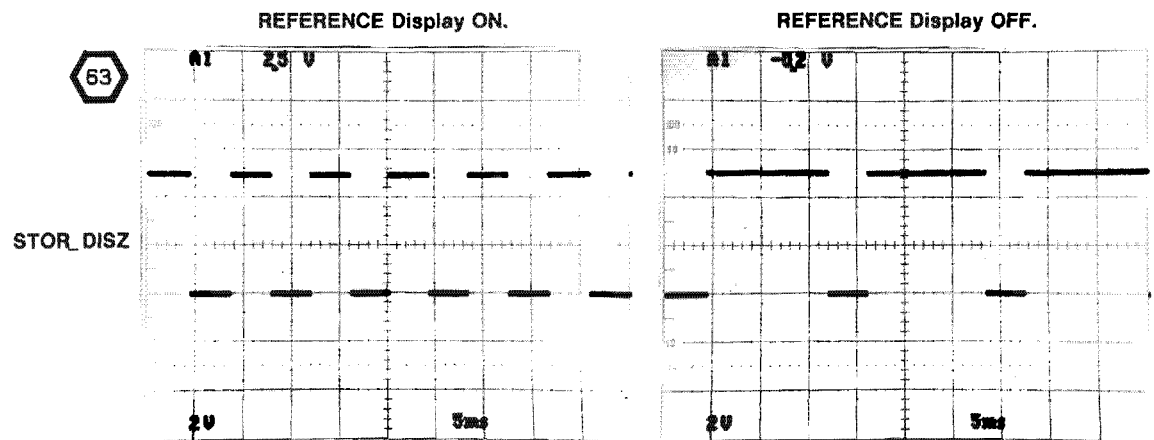
CLOCK AND TIME BASE DIAGRAM 19

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
C1767	9E	3J	CR7002	5B	7H	R7015	1G	3H	U7005A	3E	3J
C2004	9F	6J	CR7003	6B	7H	R7016	1G	3G	U7005B	3G	3J
C2255	9F	6D	CR7004	6B	7H	R7017	4B	7D	U7006	1F	4H
C7000	9C	5H	CR7005	6B	1H	R7018	2E	7G	U7007	2K	6H
C7001	9F	5H	CR7006	8D	4H	R7501	1B	2J	U7008A	2L	5H
C7002	9E	4J	CR7007	9D	6J	R7502	1B	2K	U7008B	3L	5H
C7003	7B	5K	CR7008	8F	6H	R7503	1D	2J	U7009A	6B	6H
C7004	7C	5J	CR7011	3D	6G				U7009B	6E	6H
C7005	9G	3J	CR7012	2G	6H	U1521D	1J	2G	U7009C	7F	6H
C7006	9G	4H	CR7501	1B	2J	U1787A	1K	3J	U7009D	2C	6H
C7007	9H	6H	CR7502	1C	2J	U1767B	1L	3J	U7010	6D	6H
C7008	7D	6K				U2004B	8G	7G	U7011	6F	6K
C7009	9C	4H	Q7503A	1C	6K	U2004C	9C	7G	U7012	6G	5J
C7010	9D	3K	Q7503B	1C	6K	U2004D	3C	7G	U7013	6J	5J
C7011	9D	5H				U2004E	3D	7G	U7014	7G	4J
C7012	9H	5J	R7001	2B	6H	U2255A	8H	7D	U7015A	7K	4J
C7013	9H	5J	R7002	2C	7H	U2255B	8H	7D	U7015	7H	4J
C7014	9J	4J	R7003	7B	5J	U3001C	8D	4H	U7016B	5F	5H
C7015	9J	4J	R7004	7C	5J	U3203A	1D	5G	U7016B	7K	5H
C7016	9K	5J	R7005	7D	6K	U7001	2B	5H	U7016C	4K	5H
C7017	9D	4H	R7006	7B	7H	U7002A	2C	4H	U7017A	7L	4H
C7018	3A	6J	R7007	7C	7H	U7002B	4C	4H	U7017B	3J	4H
C7068	9B	6J	R7008	8B	7H	U7002E	1J	4H	U7018A	5E	6J
C7501	1B	2K	R7009	8F	4H	U7003B	4C	5H	U7018C	8C	6J
C7502	1B	2K	R7010	2D	4H	U7003	7B	5H	U7018D	8C	6J
C7503	1C	2J	R7011	1H	3H	U7004A	3D	3H	U7068A	8E	7H
C7504	2D	2K	R7012	2M	5H	U7004B	4E	3H	U7068B	8H	7H
			R7013	4M	5H	U7004C	3F	3H	U7068C	8B	7H
CR7000	3B	7H	R7014	1L	3J	U7004D	7K	3H	U7068D	8B	7H
CR7001	3B	7H									

Partial A10 also shown on diagrams 2, 5, 6, 9, 11, 13, 14, 15, 17, 18 and 20.



WAVEFORMS FOR DIAGRAM 20

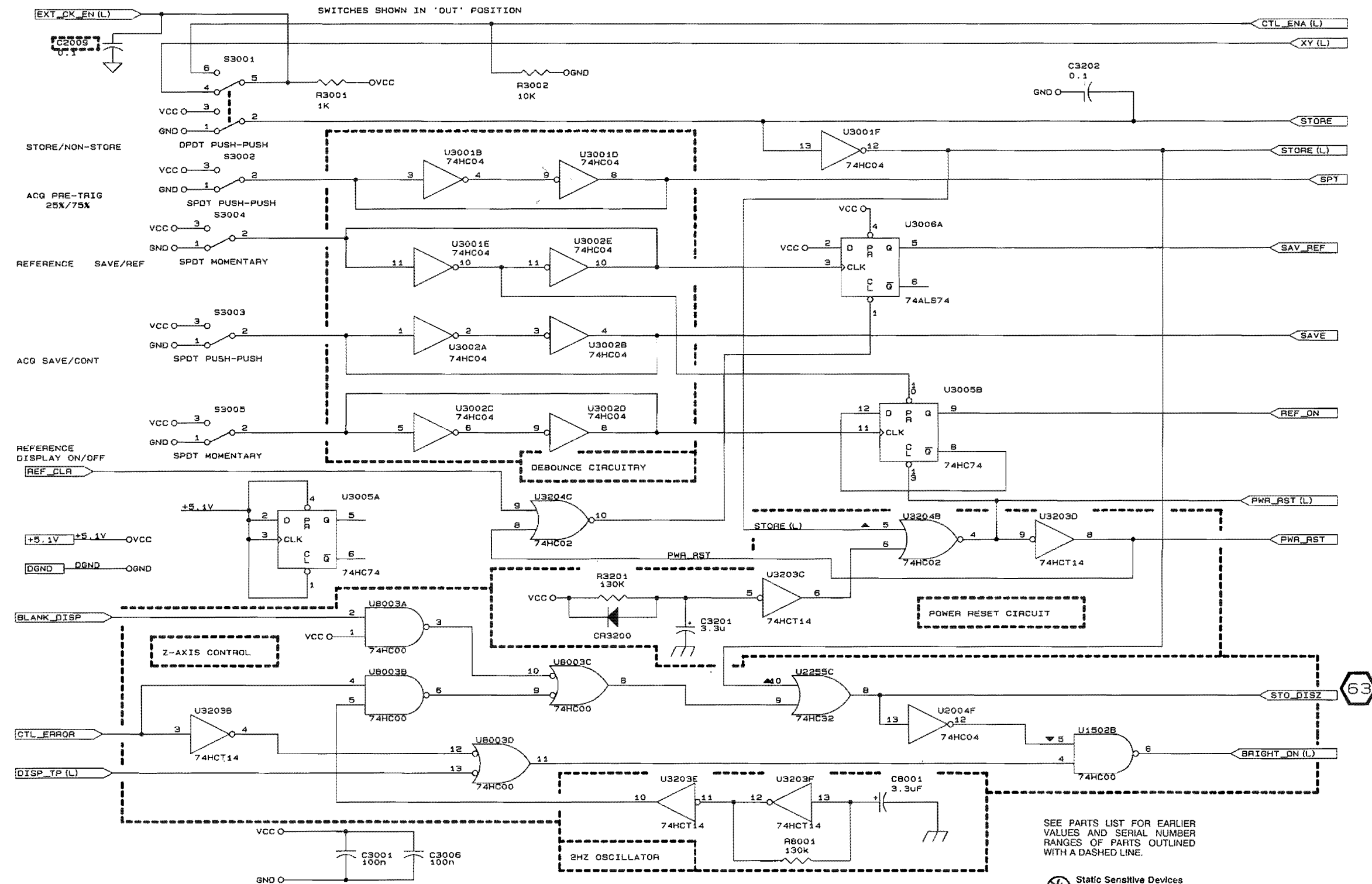


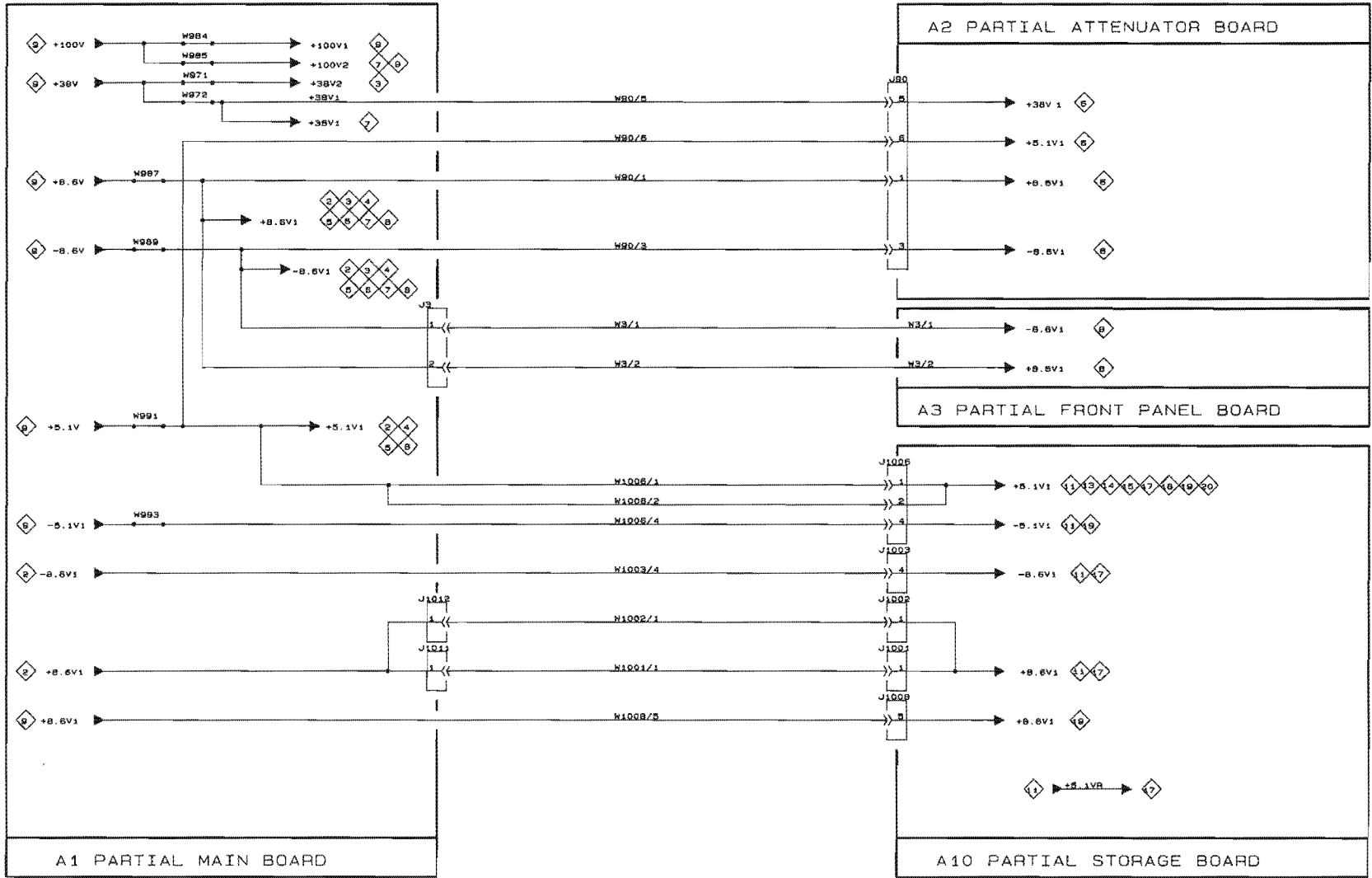
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Z-AXIS, POWER RESET and STORAGE SWITCHES DIAGRAM 20

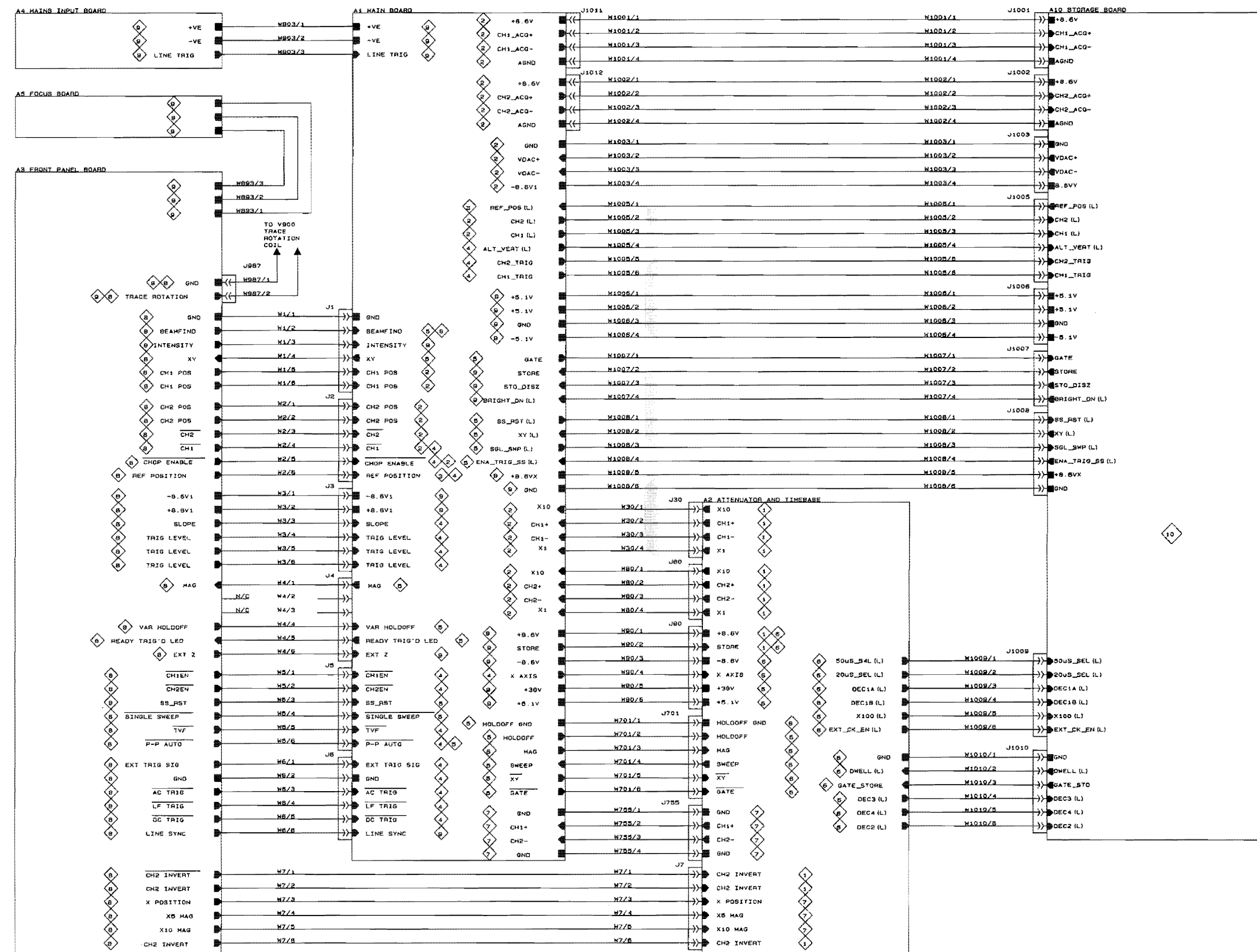
ASSEMBLY A10											
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C2009	1A	7G	R8001	6F	5G	U3001D	2D	4H	U3203B	5B	5G
C3001	6C	4J				U3001E	2D	4H	U3203C	4F	5G
C3008	6C	3G	S3001	1B	2J	U3001F	1F	4H	U3203D	4G	5G
C3201	4E	6G	S3002	2B	2J	U3002A	3D	3H	U3203E	5E	5G
C3202	1G	7D	S3003	3B	2H	U3002B	3D	3H	U3203F	5F	5G
C8001	5F	5F	S3004	2B	2H	U3002C	3D	3H	U3204B	4F	6F
			S3005	3B	2H	U3002D	3D	3H	U3204C	4D	6F
CR3200	4D	6G				U3002E	2D	3H	U8003A	4C	6G
			U1502B	5G	6G	U3005A	4C	4G	U8003B	5C	6G
R3001	1C	3J	U2004F	5G	7G	U3005B	3G	4G	U8003C	5D	6G
R3002	1D	3J	U2255C	5F	7D	U3006A	2F	3G	U8003D	5D	6G
R3201	4D	5H	U3001B	2D	4H						

Partial A10 also shown on diagrams 2, 5, 6, 9, 11, 13, 14, 15, 17, 18 and 19.





POWER DISTRIBUTION

CIRCUIT BOARD
INTERCONNECTIONS

22

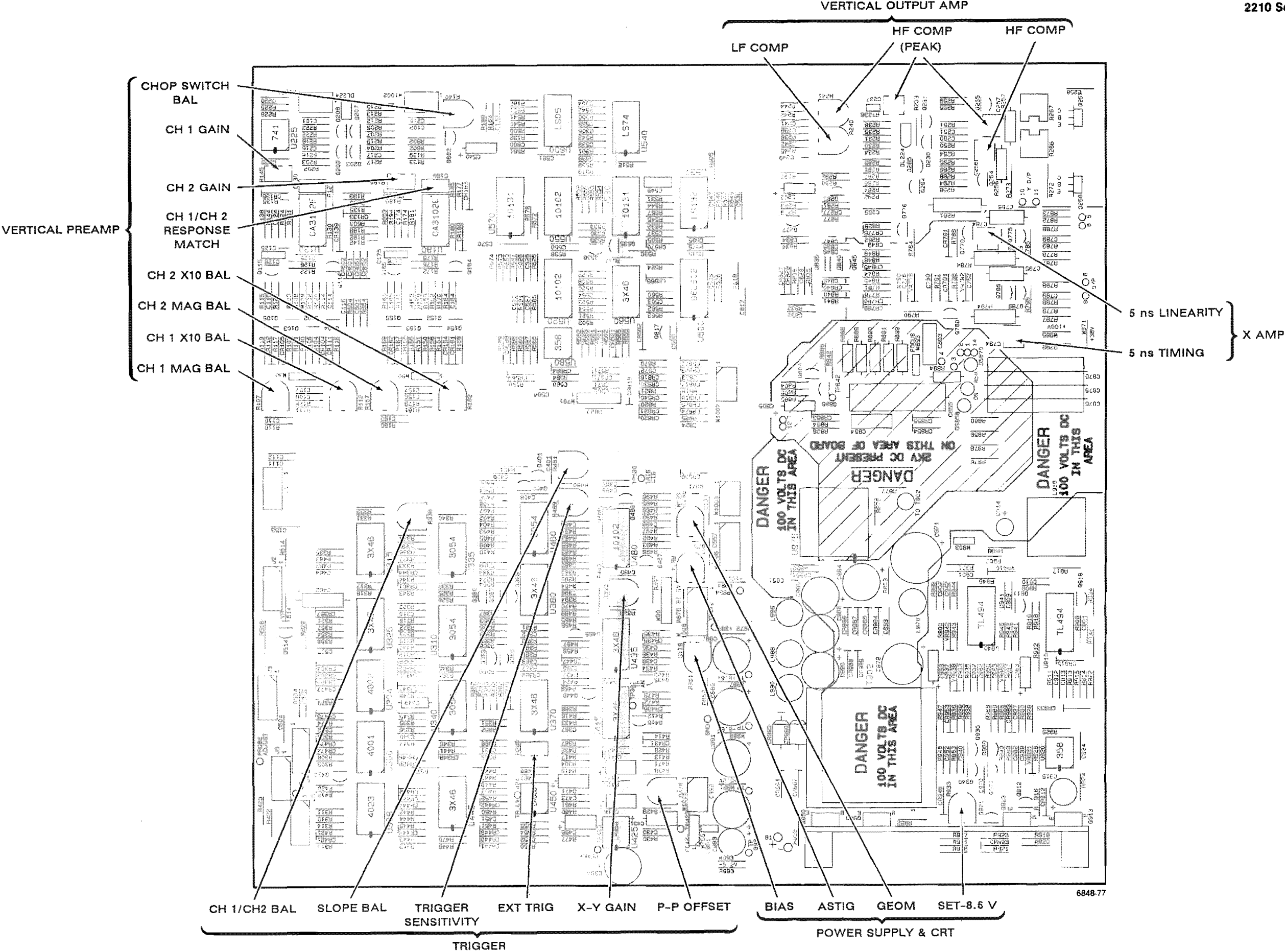


Figure 9-13. A1—Main board adjustment locations.

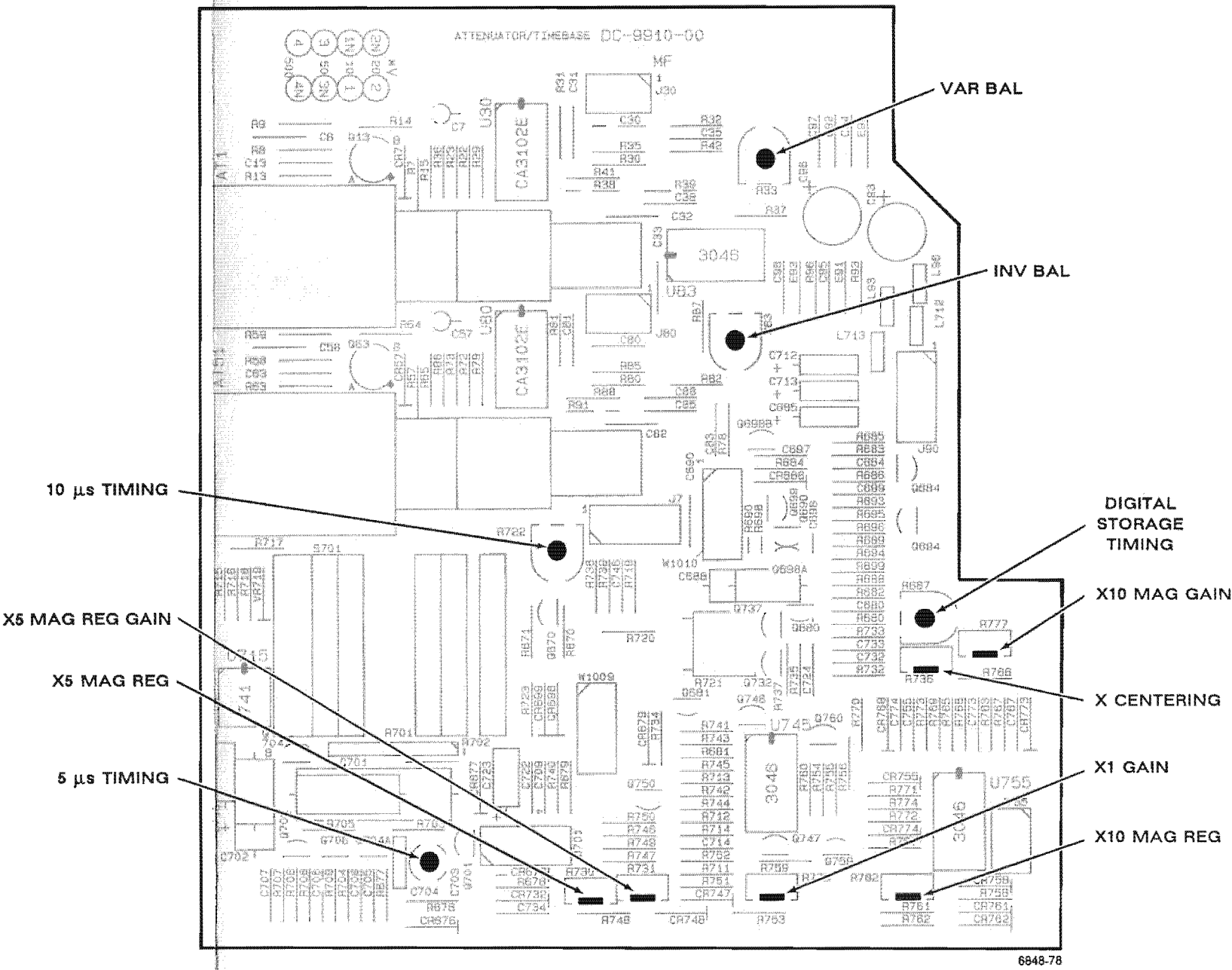


Figure 9-14. A2—Attenuator board adjustment locations.

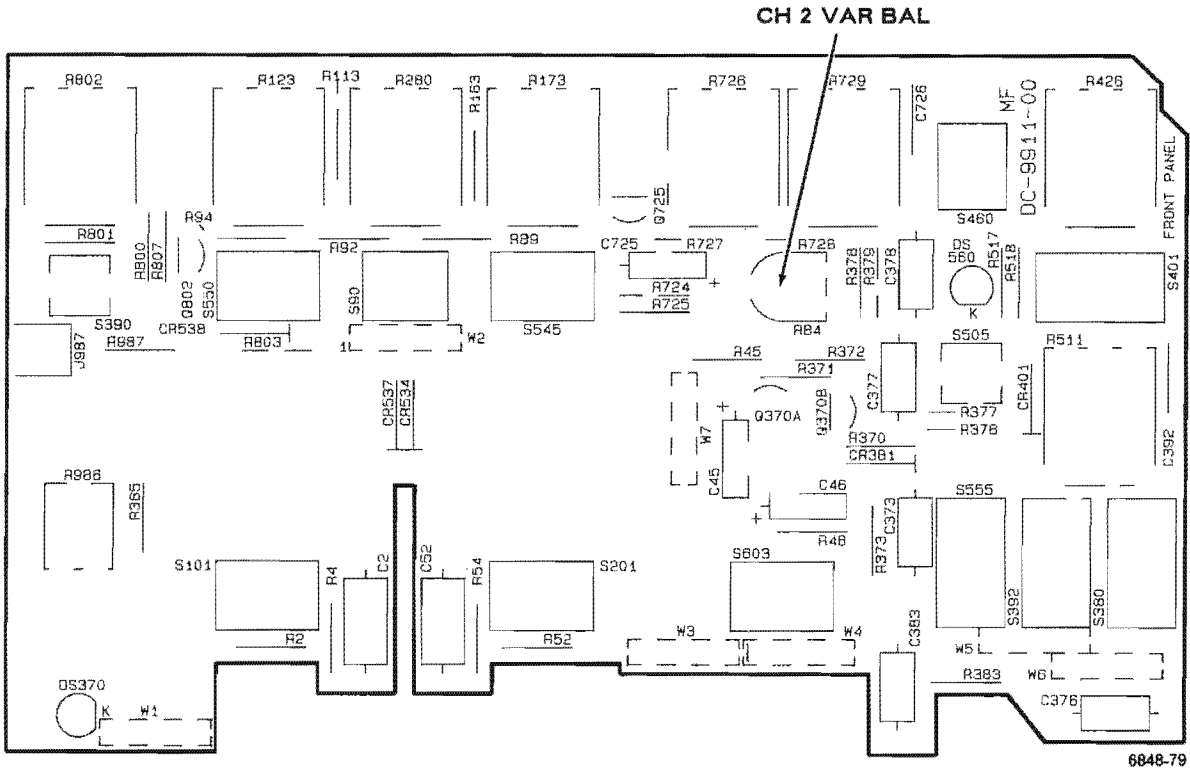
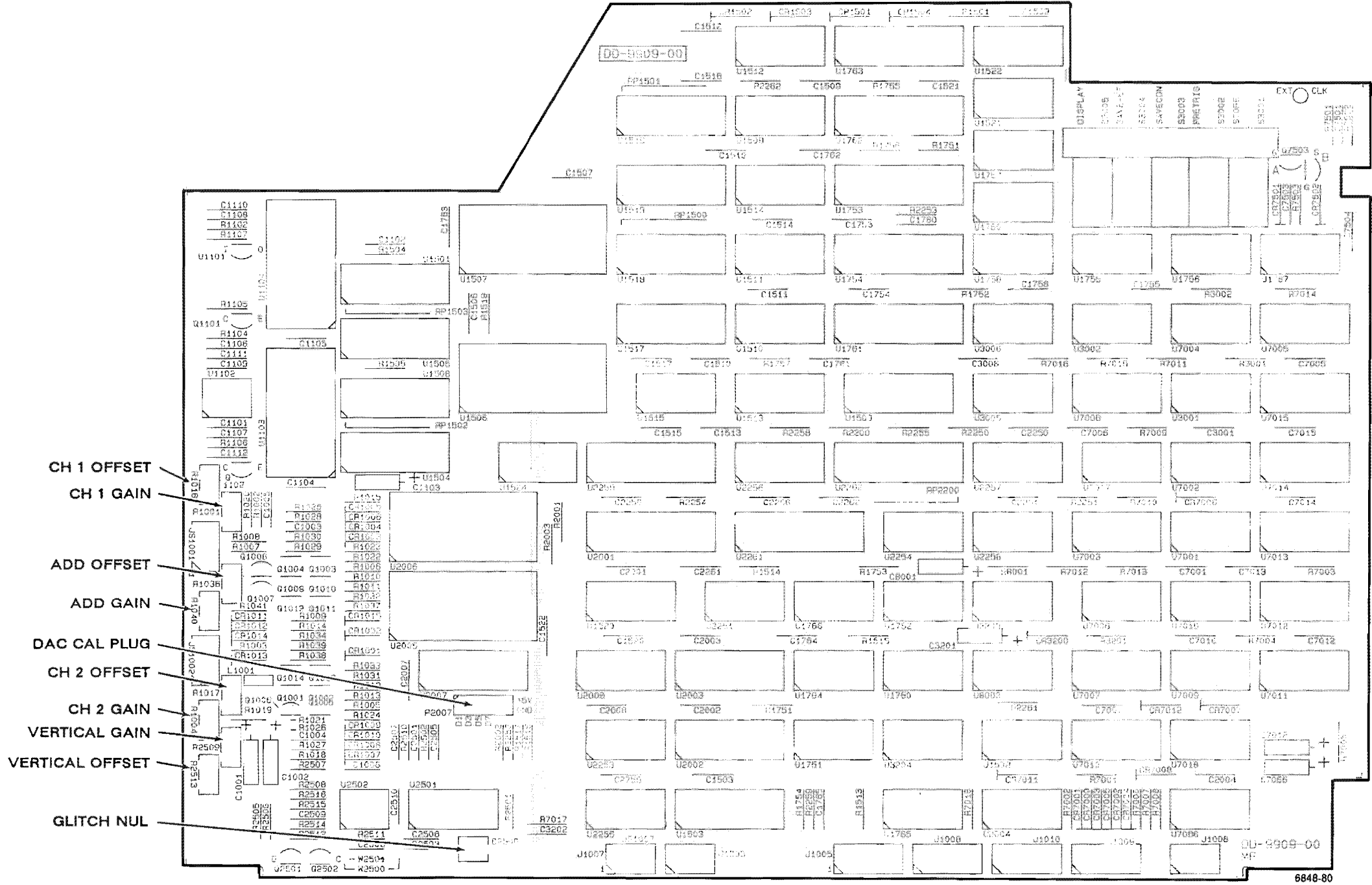


Figure 9-15. A3—Front Panel board adjustment locations.



ADJUSTMENT LOCATIONS III
FIG. 9-16

Figure 9-16. A10—Storage board adjustment locations.

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

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 indentation system used in the description column.

1 2 3 4 5 *Name & Description*

Assembly and/or Component

Attaching parts for Assembly and/or Component

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 of 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 Standards Institute Y1.1

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
01536	TEXTRON INC CAMCAR DIV SEMS PRODUCTS UNIT	1818 CHRISTINA ST	ROCKFORD IL 61108
06383	PANDUIT CORP	17301 RIDGELAND	TINLEY PARK IL 07094-2917
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
16428	COOPER BELDEN ELECTRONIC WIRE AND CA SUB OF COOPER INDUSTRIES INC	NW N ST	RICHMOND IN 47374
22670	G M NAMEPLATE INC	2040 15TH AVE WEST	SEATTLE WA 98119-2728
70903	COOPER BELDEN ELECTRONICS WIRE AND C SUB OF COOPER INDUSTRIES INC	2000 S BATAVIA AVE	GENEVA IL 60134-3325
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97707-0001
83385	MICRODOT MFG INC GREER-CENTRAL DIV	3221 W BIG BEAVER RD	TROY MI 48098
83486	ELCO INDUSTRIES INC	1101 SAMUELSON RD	ROCKFORD IL 61101
86113	MICRODOT MFG INC CENTRAL SCREW-KEENE DIV	149 EMERALD ST	KEENE NH 03431-3628
93907	TEXTRON INC CAMCAR DIV	600 18TH AVE	ROCKFORD IL 61108-5181
S3109	FELLER	ASA ADOLF AG STOTZWEID CH8810	HORGEN SWITZERLAND
S3629	SCHURTER AG H C/O PANEL COMPONENTS CORP	2015 SECOND STREET	BERKELEY CA 94170
TK0174	BADGLEY MFG CO	1620 NE ARGYLE	PORTLAND OR 97211
TK0861	H SCHURTER AG DIST PANEL COMPONENTS	2015 SECOND STREET	BERKELEY CA 94170
TK0DA	MET-ETCH (SELKIRK) LTD		SELKIRK TD75DK SCOTLAND
TK0EB	B D TOOLS	237 BULLSMOOR LAND ENFIELD	MIDDX ENGLAND
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
TK0ET	WARTH INTERNATIONAL CHARLWOODS BUSINESS CENTER	CHARLWOODS ROAD	EAST GRINDSTEAD ENGLAND
TK0EX	LUCAS DURALITH LTD STATION APPROACH	VICTORIA ROCHE	CORNWALL PL28 8JU ENGLAND
TK1326	NORTHWEST FOURSIDE INC	18224 SW 100TH CT	TUALATIN OR 97062
TK1336	PARSONS MFG CORP	1055 OBRIEN	MENLO PARK CA 94025
TK1373	PATELEC-CEM (ITALY)	10156 TORINO	VAICENTALLO 62/45S ITALY
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
TK2165	TRIQUEST CORP	3000 LEWIS AND CLARK HWY	VANCOUVER WA 98661-2999

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective Discnt	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-1	334-6879-00		1	MARKER,IDENT:MARKED VOLTAGE/FUSE SELECT	TK0DA	ORDER BY DESCR
-2	334-6880-00		1	MARKER,IDENT:MARKED CAUTION	TK0DA	ORDER BY DESCR
-3	334-5257-00		1	MARKER,IDENT:MKD X-RAY	TK1694	ORDER BY DESCR
	334-5258-00		1	MARKER,IDENT:MKD X-RAY WARNING,GERMAN	TK1694	ORDER BY DESCR
-4	200-3335-01		1	COVER,REAR:	80009	200-3335-01
				ATTACHING PARTS		
-5	211-0712-00		2	SCR,ASSEM WSHR:6-32 X 1.25,PNH,STL,TORX	01536	ORDER BY DESCR
				END ATTACHING PARTS		
-6	343-1278-00		2	RTNR,POWER CORD:POLYCARBONATE GRAY	TK2165	ORDER BY DESCR
-7	348-0964-00		2	FOOT,REAR COVER:BLACK,PLASTIC	TK0EJ	ORDER BY DESCR
-8	390-1036-00		1	CABINET,SCOPE:	TK0EO	ORDER BY DESCR
				ATTACHING PARTS		
-9	213-0882-00		2	SCREW,TPG,TR:6-32 X 0.437 TAPTITE,PNH,STL	83385	ORDER BY DESCR
				END ATTACHING PARTS		
-10	367-0356-00		1	HANDLE,CARRYING:	TK0EJ	ORDER BY DESCR
				ATTACHING PARTS		
-11	212-0144-00		2	SCREW,TPG,TF:8-16 X 0.562,PLASTITE,SPCL HD	93907	225-38131-012
				END ATTACHING PARTS		
-12	214-3984-00		2	SPRING,HLCPS:0.71 OD X 12.0MM L,OPEN ENDS	TK0EH	ORDER BY DESCR
-13	426-1765-02		1	FRAME,CRT:POLYCARBONATE,GRAY	TK2165	ORDER BY DESCR
				ATTACHING PARTS		
-14	211-0690-01		2	SCREW,MACHINE:6-32 X 0.875 PNH,SST	86113	ORDER BY DESCR
				END ATTACHING PARTS		
-15	337-2775-00		1	SHLD,IMPLOSION:FILTER,BLUE	80009	337-2775-00
-16	348-0660-00		4	CUSHION,CRT:POLYURETHANE	80009	348-0660-00
-17	384-1575-00		1	EXTENSION SHAFT:8.805 L,W/KNOB,PLASTIC	80009	384-1575-00
-18	358-0550-00		1	BUSHING,SHAFT:0.15 ID X 0.488 L,PLSTC	TK2165	ORDER BY DESCR
-19	366-1480-03		1	PUSH BUTTON:BLACK,OFF	80009	366-1480-03
-20	384-1364-00		1	EXTENSION SHAFT:10.818 L X 0.187 SQ,NYL,BLK	TK2165	ORDER BY DESCR
-21	366-0641-00		2	KNOB:GY/YL,CAL/X10,11.5MM X 3.08MM X 13MM H	TK0ES	ORDER BY DESCR
-22	331-0498-00		2	DIAL,CONTROL:32MM X 3.75MM,MKD 1 THRU 50	TK0EJ	ORDER BY DESCR
-23	210-1436-00		2	WASHER,FLAT:9.4MM X 12.5MM X 2MM,AL	TK0EL	ORDER BY DESCR
-24	366-0640-00		1	KNOB:GRAY,CAL W/ARROW,10MM X 2MM X 12MM H	TK0ES	ORDER BY DESCR
-25	331-0499-00		1	DIAL,CONTROL:32MM X 3.75MM,MKD 2 X LINES	TK0EJ	ORDER BY DESCR
-26	366-0636-00		8	KNOB:GRAY,10MM X 12MM H	TK0EJ	ORDER BY DESCR
-27	366-0635-00		2	PUSH BUTTON:GRAY,4.45MM X 7.75MM X	TK0EJ	ORDER BY DESCR
-28	-----		1	TERM,FEEDTHRU:(SEE J590 REPL)		
-29	-----		3	CONN,RCPT,ELEC:BNC(SEE J100,J151,J300 REPL)		
-30	210-0255-00		3	TERMINAL,LUG:0.391 ID,LOCKING,BRS CD PL	12327	ORDER BY DESCR
-31	386-5483-00		1	SUBPANEL,FRONT:	TK0EJ	ORDER BY DESCR
-32	333-3566-00		1	PANEL,FRONT:	80009	333-3566-00

FIG. 1 CABINET

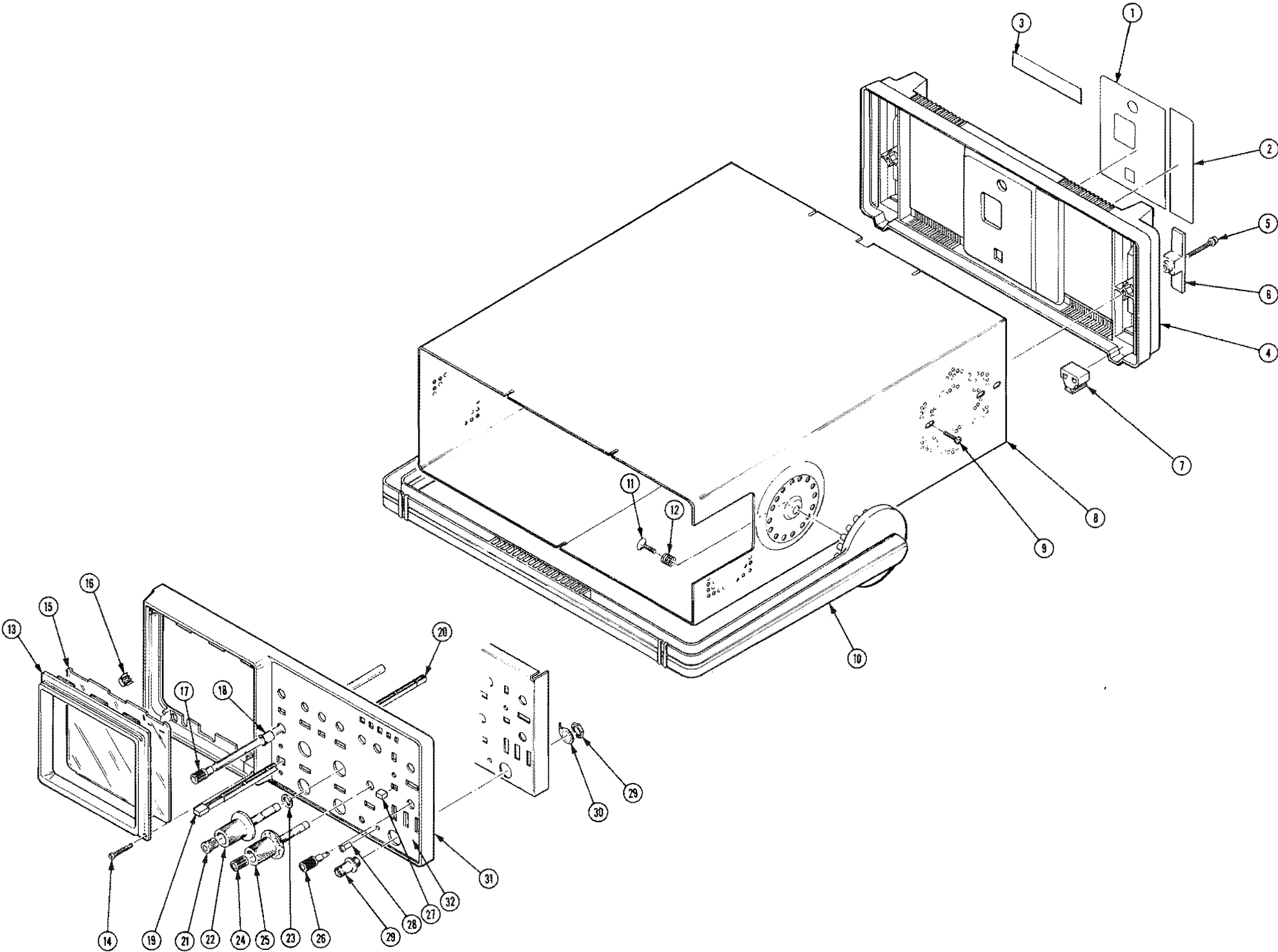


FIG. 2 CHASSIS

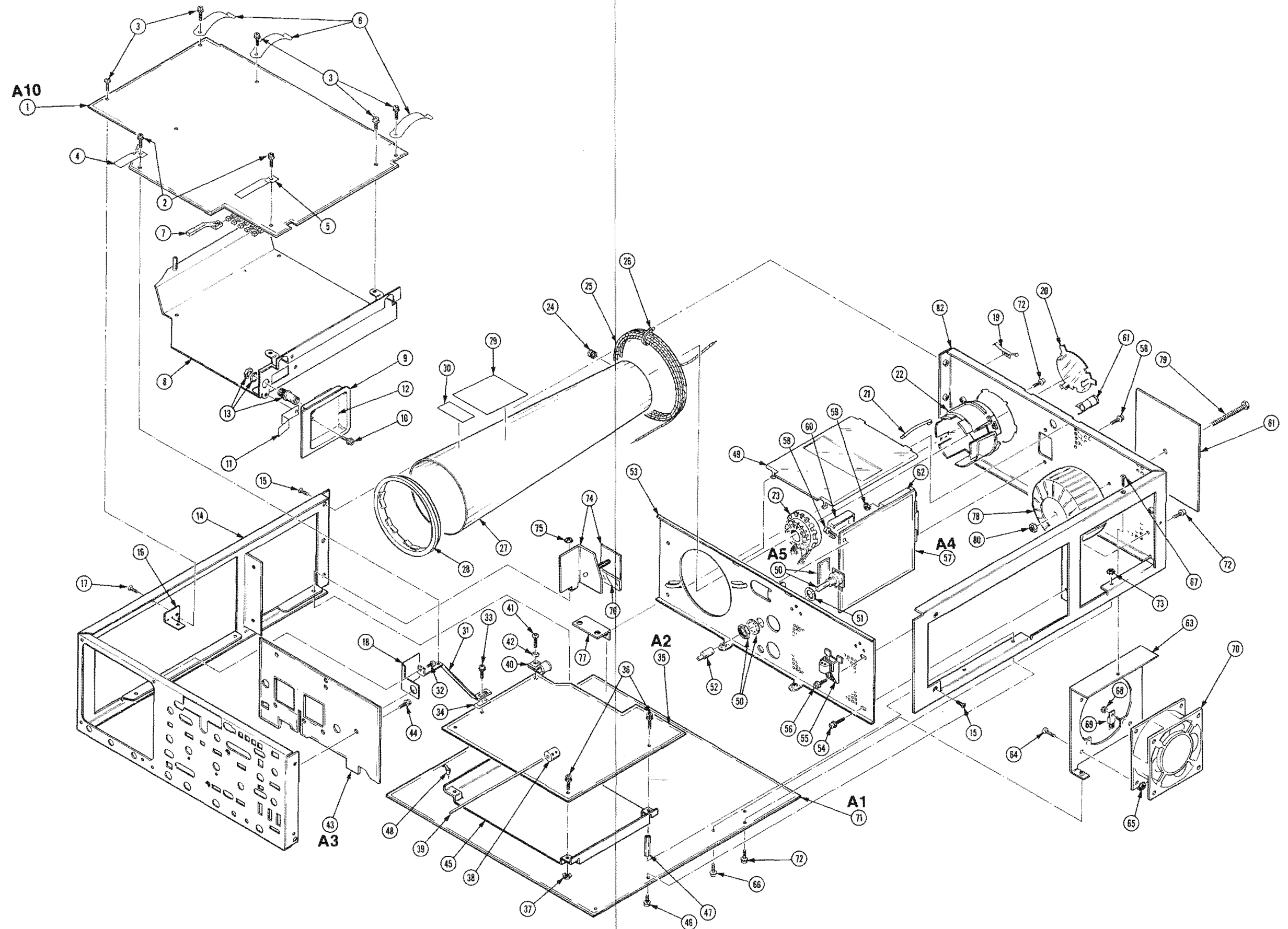


Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2-1	-----		1	CIRCUIT BD ASSY:STORAGE (SEE A10 REPL) ATTACHING PARTS		
-2	213-0881-00		2	SCREW,TPG,TR:6-32 X 0.25 TYPE TT,FILH,STL	83385	ORDER BY DESCR
-3	213-0882-00		5	SCREW,TPG,TR:6-32 X 0.437 TAPTITE,PNH,STL END ATTACHING PARTS	83385	ORDER BY DESCR
-4	214-4151-00		1	SPRING,GROUND:PH BR,NI PL	80009	214-4151-00
-5	214-4152-00		1	SPRING,GROUND:PH BR,NI PL	80009	214-4152-00
-6	214-4153-00		3	SPRING,GROUND:PH BR,NI PL	80009	214-4153-00
-7	366-0678-00		5	PUSHBUTTON:OFF,DOVE GRAY	80009	366-0678-00
-8	337-3475-00		1	SHIELD,ELEC:CKT BD,2210	TK0EO	ORDER BY DESCR
-9	386-5712-00		1	SUBPANEL,SIDE: ATTACHING PARTS	TK0EJ	ORDER BY DESCR
-10	211-0730-00		1	SCR,ASSEM WSHR:6-32 X 0.375,PNH,STL,T15 END ATTACHING PARTS	80009	211-0730-00
-11	214-4154-00		1	SPRING,GROUND:PH BR,NI PL	80009	214-4154-00
-12	334-7142-00		1	OVERLAY,PANEL:SIDE,2210	TK0EX	ORDER BY DESCR
-13	-----		1	CONN,RCPT,ELEC:BNC (SEE A10J7500 REPL)		
-14	441-1752-01		1	CABINET,SCOPE:FRONT ATTACHING PARTS	TK0EO	ORDER BY DESCR
-15	211-0718-00		4	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL END ATTACHING PARTS	83486	ORDER BY DESCR
	344-0367-01		8	CLIP,GROUND:CU-BE	80009	344-0367-01
-16	407-3698-00		1	BRACKET,CKT BD:CHASSIS SIDE,STL ATTACHING PARTS	TK0EO	ORDER BY DESCR
-17	211-0718-00		1	SCREW,MACHINE:6-32 X 0.312,FLH,100 DEG,STL END ATTACHING PARTS	83486	ORDER BY DESCR
-18	337-3397-00		1	SHIELD,ELEC:CH1,CH2 SEPARATION	TK0EO	ORDER BY DESCR
-19	214-4155-00		5	SPRING,GROUND:PH BR,NI PL	80009	214-4155-00
-20	200-2519-00		1	CAP,CRT SOCKET:NATURAL LEXAN	80009	200-2519-00
-21	214-1061-05		1	SPRING,GROUND:PLATED	TK1326	ORDER BY DESCR
-22	426-1766-00		1	MOUNT,RESILIENT:CRT,REAR	80009	426-1766-00
-23	136-0202-04		1	SKT,PL-IN ELEK:ELECTRON TUBE,14 CONTACT	80009	136-0202-04
-24	214-3984-00		1	SPRING,HLCP:0.71 OD X 12.0MM L,OPEN ENDS	TK0EH	ORDER BY DESCR
-25	-----		1	DELAY LINE,ELEC:(SEE A1DL224 REPL)		
-26	343-0549-00		6	STRAP,TIEDOWN,E:0.091 W X 4.0 L,ZYTEL	06383	PLT1M
-27	337-3363-00		1	SHIELD,ELEC:CRT	TK1723	ORDER BY DESCR
-28	386-4443-00		1	SUPPORT,SHIELD:CRT,FRONT,PLASTIC	80009	386-4443-00
-29	334-1951-00		1	MARKER,IDENT:MKD WARNING,CRT VOLTAGES	22670	ORDER BY DESCR
-30	334-1379-00		1	MARKER,IDENT:MKD HI VACUUM	07416	ORDER BY DESCR
-31	386-5711-00		1	SUPPORT,CKT BD:FRONT ATTACHING PARTS	TK0EO	ORDER BY DESCR
-32	211-0730-00		1	SCR,ASSEM WSHR:6-32 X 0.375,PNH,STL,T15	80009	211-0730-00
-33	213-0882-00		1	SCREW,TPG,TR:6-32 X 0.437 TAPTITE,PNH,STL END ATTACHING PARTS	83385	ORDER BY DESCR
-34	337-3422-00	200182	1	SHIELD,ELEC:	TK0EJ	ORDER BY DESCR
-35	-----		1	CIRCUIT BD ASSY:ATTEN/T.B. (SEE A2 REPL) ATTACHING PARTS		
-36	211-0730-00		3	SCR,ASSEM WSHR:6-32 X 0.375,PNH,STL,T15	80009	211-0730-00
-37	210-0457-00		1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL END ATTACHING PARTS	78189	511-061800-00
	346-0240-00		1	STRAP,GROUNDING:ATTENUATOR (SOLDER BRACKET ACCROSS THE INNER TWO LEADS FROM THE ATTENUATOR SWITCHES)	TK0EO	ORDER BY DESCR
-38	376-0224-01		1	CPLG,SHAFT,RGDR:W/213-0153-00	TK0EC	ORDER BY DESCR
-39	384-1740-00		1	SHAFT,EXTENSION:2MM OD X 145.7MM L	80009	384-1740-00
-40	343-0003-00		1	CLAMP,LOOP:0.25 ID,PLASTIC ATTACHING PARTS	06915	E4 CLEAR ROUND
-41	211-0730-00		1	SCR,ASSEM WSHR:6-32 X 0.375,PNH,STL,T15	80009	211-0730-00
-42	210-0803-00		1	WASHER,FLAT:0.15 ID X 0.375 OD X 0.032,STL END ATTACHING PARTS	12327	ORDER BY DESCR
-43	-----		1	CIRCUIT BD ASSY:FR PNL (SEE A3 REPL) ATTACHING PARTS		
-44	211-0304-00		6	SCR,ASSEM WSHR:4-40 X 0.312,PNH,STL,T9 TORX END ATTACHING PARTS	01536	ORDER BY DESCR
-45	337-3365-00		1	SHIELD,ELEC:ATTENUATOR ATTACHING PARTS	TK0EO	ORDER BY DESCR
-46	211-0730-00		3	SCR,ASSEM WSHR:6-32 X 0.375,PNH,STL,T15	80009	211-0730-00

Replaceable Mechanical Parts - 2210 Service

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
2-47	129-1105-00		2	SPACER, POST: 23.5MM L, 4-40 BOTH ENDS, AL, HEX	TKOEL	ORDER BY DESCR
	129-1106-00		1	SPACER, POST: 25.4MM L, W 6-32 THD THRU, BRS	TKOEL	ORDER BY DESCR
				END ATTACHING PARTS		
-48	343-0088-00		2	CLAMP, CABLE: 0.062 DIA, PLASTIC	80009	343-0088-00
-49	337-3364-01		1	SHIELD, ELEC: POWER SUPPLY	TKOEJ	ORDER BY DESCR
-50	-----		1	CIRCUIT BD ASSY: FOCUS CONT (SEE A5 REPL)		
-51	210-1437-00		1	WASHER, FLAT: 0.265 ID X 0.06 THK, STEEL	TKOEI	ORDER BY DESCR
-52	384-1710-00		1	EXTENSION SHAFT: 13MM X 7MM OD, W/STEP, 4MM ID	TKOEJ	ORDER BY DESCR
-53	441-1751-02		1	CHASSIS, SCOPE: INNER	80009	441-1751-02
				ATTACHING PARTS		
-54	213-0882-00		2	SCREW, TPG, TR: 6-32 X 0.437 TAPTITE, PNH, STL	83385	ORDER BY DESCR
				END ATTACHING PARTS		
-55	407-3697-00		2	BRACKET, SUPPORT: CKT BD, PLASTIC	TKOEJ	ORDER BY DESCR
				ATTACHING PARTS		
-56	213-0882-00		2	SCREW, TPG, TR: 6-32 X 0.437 TAPTITE, PNH, STL	83385	ORDER BY DESCR
				END ATTACHING PARTS		
-57	-----		1	CIRCUIT BD ASSY: POWER (SEE A4 REPL)		
				ATTACHING PARTS		
-58	211-0730-00		6	SCR, ASSEM WSHR: 6-32 X 0.375, PNH, STL, T15	80009	211-0730-00
-59	210-0457-00		2	NUT, PL, ASSEM WA: 6-32 X 0.312, STL CD PL	78189	511-061800-00
				END ATTACHING PARTS		
-60	200-2735-00		1	COVER, POWER SW: BLACK, POLYCARBONATE	TK2165	ORDER BY DESCR
	343-0549-00	200259	1	STRAP, TIEDOWN, E: 0.091 W X 4.0 L, ZYTEL	06383	PLTIM
-61	200-2264-00		1	CAP, FUSEHOLDER: 3AG FUSES	S3629	FEK 031 1666
-62	204-0906-00		1	BODY, FUSEHOLDER: 3AG & 5 X 20MM FUSES	S3629	TYPEFAU031.3573
-63	407-3699-00	200001	1	BRKT, HEAT SINK: FAN MTG, ALUMINUM	TKOEX	ORDER BY DESCR
	407-3699-01	200411	1	BRACKET, HT SK: FAN MTG, ALUM	80009	407-3699-01
				ATTACHING PARTS		
-64	211-0730-00		2	SCR, ASSEM WSHR: 6-32 X 0.375, PNH, STL, T15	80009	211-0730-00
-65	210-0457-00		2	NUT, PL, ASSEM WA: 6-32 X 0.312, STL CD PL	78189	511-061800-00
-66	211-0304-00		2	SCR, ASSEM WSHR: 4-40 X 0.312, PNH, STL, T9 TORX	01536	ORDER BY DESCR
-67	211-0718-00		3	SCREW, MACHINE: 6-32 X 0.312, FLH, 100 DEG, STL	83486	ORDER BY DESCR
-68	210-0457-00		4	NUT, PL, ASSEM WA: 6-32 X 0.312, STL CD PL	78189	511-061800-00
				END ATTACHING PARTS		
-69	-----		4	TRANSISTOR: (SEE A1Q912, Q913, Q950, Q980 REPL)		
	342-0829-00		3	INSULATOR, PLATE: TRANSISTOR, SIL-PAD	TKOET	ORDER BY DESCR
	342-0804-00		1	INSULATOR, WSHR: 5.6MM X 3.0MM X 1.6MM, NYLON	80009	342-0804-00
-70	-----		1	FAN, TUBAXIAL: (SEE A1B1 REPL)		
-71	-----		1	CIRCUIT BD ASSY: MAIN (SEE A1 REPL)		
				ATTACHING PARTS		
-72	211-0730-00		8	SCR, ASSEM WSHR: 6-32 X 0.375, PNH, STL, T15	80009	211-0730-00
-73	210-0457-00		5	NUT, PL, ASSEM WA: 6-32 X 0.312, STL CD PL	78189	511-061800-00
				END ATTACHING PARTS		
-74	214-4084-01		1	HT SK, XSTR ASSY:	80009	214-4084-01
				ATTACHING PARTS		
-75	220-0103-00		4	NUT: 4-40, 0.25, STL ZN PL	TKOEI	ORDER BY DESCR
	210-0091-00		4	WASHER, LOCK: #4, 0.005 THK	TKOEI	ORDER BY DESCR
				END ATTACHING PARTS		
-76	006-7146-00		1	PROTECTOR, EDGE: CHANNEL, GRAY, 160MM L	80009	006-7146-00
-77	407-3733-00		1	BRACKET, HT SK: ALUMINUM	TKOEO	ORDER BY DESCR
-78	-----		1	TRANSFORMER, RF: (SEE T901 REPL)		
				ATTACHING PARTS		
-79	213-0993-00		1	SCREW, MACHINE: 0.25-20 X 2.5 L, HEX HEAD, STL	TKOEB	ORDER BY DESCR
-80	220-0054-00		2	NUT, PLAIN, HEX: 0.25-20 X 0.437 HEX, STL, ZN PL	TKOEB	ORDER BY DESCR
				END ATTACHING PARTS		
-81	386-5361-00		1	PLATE, REAR: STEEL	TKOEO	ORDER BY DESCR
-82	441-1753-01		1	CABINET, SCOPE: REAR	TKOEO	ORDER BY DESCR

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective Dscont	Qty	12345	Name & Description	Mfr. Code	Mfr. Part No.
3-					STANDARD ACCESSORIES		
	-----		1		ACCESSORY PKG:TWO P6103 PROBE,PSIV W/ACCESS		
	070-6847-00		1		MANUAL,TECH:OPERATORS,2210	80009	070-6847-00
	070-6898-00		1		MANUAL,TECH:OPERATORS REF GUIDE,2210	80009	070-6898-00
-1	161-0104-00		1		CABLE ASSY,PWR,:3 WIRE,98.0 L,W/RTANG CONN (UNITED KINGDOM ONLY)	16428	CH8352, FH-8352
	161-0230-01		1		CABLE ASSY,PWR,:3,18 AWG,92.0 L (USA ONLY)	80009	161-0230-01
-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	83385	ORDER BY DESCR
-4	210-0803-00		1		WASHER,FLAT:0.15 ID X 0.375 OD X 0.032,STL	12327	ORDER BY DESCR
	020-0859-00		1		COMPONENT KIT:EUROPEAN	80009	020-0859-00
	200-2265-00		1		.CAP,FUSEHOLDER:5 X 20MM FUSES	TK0861	FEK 031.1663
-5	161-0104-06		1		.CABLE ASSY,PWR,:3 X 0.75MM SQ,220V,98.0 L (OPTION A1 ONLY)	S3109	ORDER BY DESCR
	020-0860-00		1		COMPONENT KIT:UNITED KINGDOM	80009	020-0860-00
	200-2265-00		1		.CAP,FUSEHOLDER:5 X 20MM FUSES	TK0861	FEK 031.1663
-6	161-0104-07		1		.CABLE ASSY,PWR,:3 X 0.75MM SQ,240V,98.0 L (OPTION A2 ONLY)	TK1373	A25UK-RA
	020-0861-00		1		COMPONENT KIT:AUSTRALIAN	80009	020-0861-00
	200-2265-00		1		.CAP,FUSEHOLDER:5 X 20MM FUSES	TK0861	FEK 031.1663
-7	161-0104-05		1		.CABLE ASSY,PWR,:3,18 AWG,240V,98.0 L (OPTION A3 ONLY)	S3109	ORDER BY DESCR
	020-0862-00		1		COMPONENT KIT:NORTH AMERICAN	80009	020-0862-00
	200-2265-00		1		.CAP,FUSEHOLDER:5 X 20MM FUSES	TK0861	FEK 031.1663
-8	161-0104-08		1		.CABLE ASSY,PWR,:3,18 AWG,240V,98.0 L (OPTION A4 ONLY)	70903	ORDER BY DESCR
	020-0863-00		1		COMPONENT KIT:SWISS	80009	020-0863-00
	200-2265-00		1		.CAP,FUSEHOLDER:5 X 20MM FUSES	TK0861	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 DESCR
					OPTIONAL ACCESSORIES		
	016-0180-00		1		VISOR,CRT:FOLDING	TK2165	ORDER BY DESCR
	016-0566-00		1		VISOR,CRT:	TK2165	ORDER BY DESCR
	016-0592-00		1		VISOR,CRT:	TK2165	ORDER BY DESCR
	016-0677-02		1		POUCH,ACCESSORY:	TK0174	016-0677-02
	016-0785-00		1		ACCESSORY KIT:MOUNTING,1107 TO 2200	80009	016-0785-00
	016-0792-01		1		CASE,CARRYING:24.5 X 16.5 X 11.5	TK1336	ORDER BY DESCR
	016-0819-00		1		ADAPTER,RACK:MODIFIED 016-0466-00	80009	016-0819-00
	020-1514-00		1		ACCESSORY KIT:	80009	020-1514-00
	067-1373-00		1		FIXTURE,CAL:VERTICAL DAC,2210	80009	067-1373-00
	070-6848-00		1		MANUAL,TECH:SERVICE,2210	80009	070-6848-00
	200-3397-00		1		COVER,SCOPE:FRONT	80009	200-3397-00
	337-2775-01		1		SHLD,IMPLOSION:	80009	337-2775-01

