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TEKTRONIX®

613

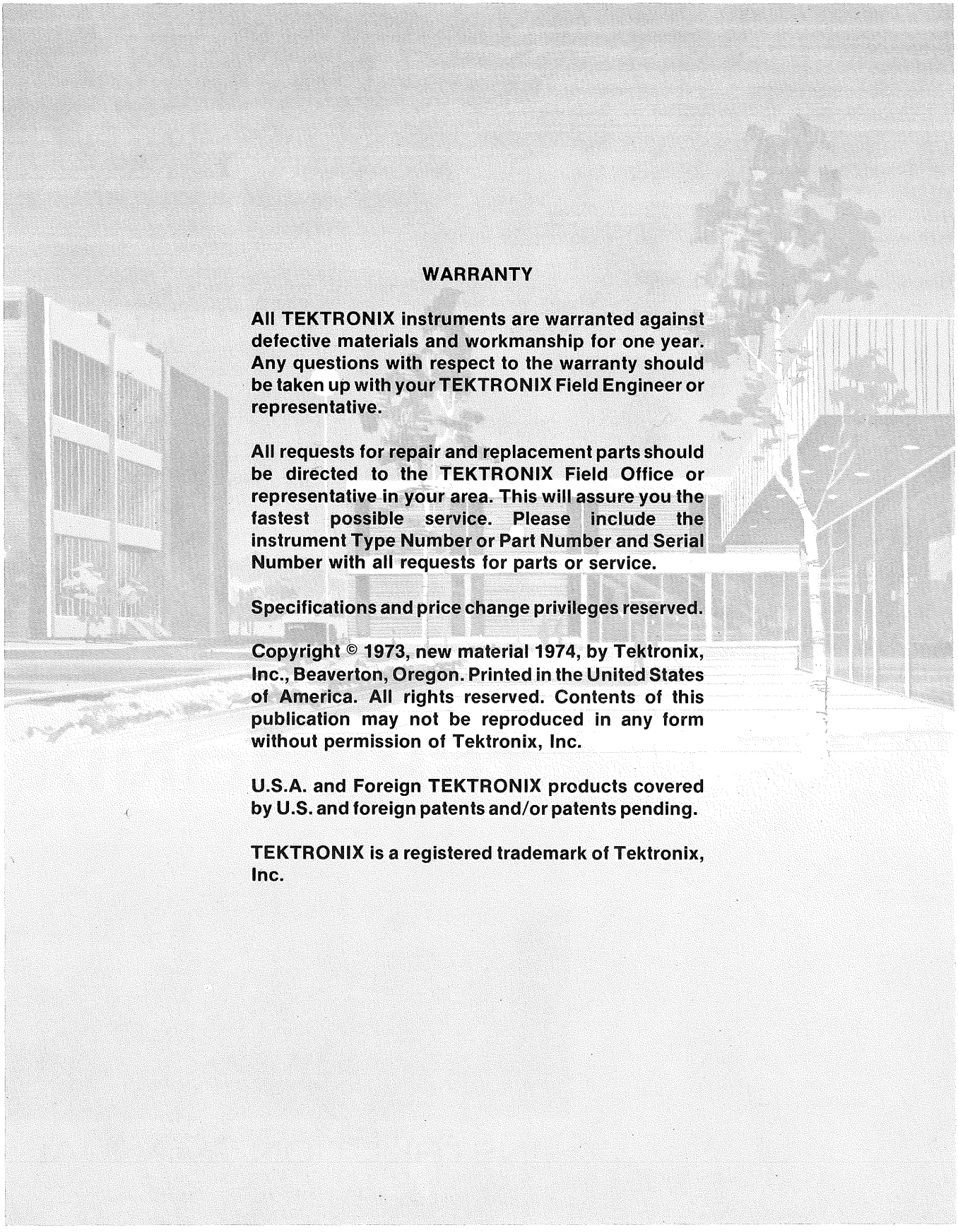
STORAGE DISPLAY UNIT

INSTRUCTION MANUAL

Tektronix, Inc.
P.O. Box 500
Beaverton, Oregon 97005

Serial Number _____

070-1407-01



WARRANTY

All TEKTRONIX instruments are warranted against defective materials and workmanship for one year. Any questions with respect to the warranty should be taken up with your TEKTRONIX Field Engineer or representative.

All requests for repair and replacement parts should be directed to the TEKTRONIX Field Office or representative in your area. This will assure you the fastest possible service. Please include the instrument Type Number or Part Number and Serial Number with all requests for parts or service.

Specifications and price change privileges reserved.

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TABLE OF CONTENTS

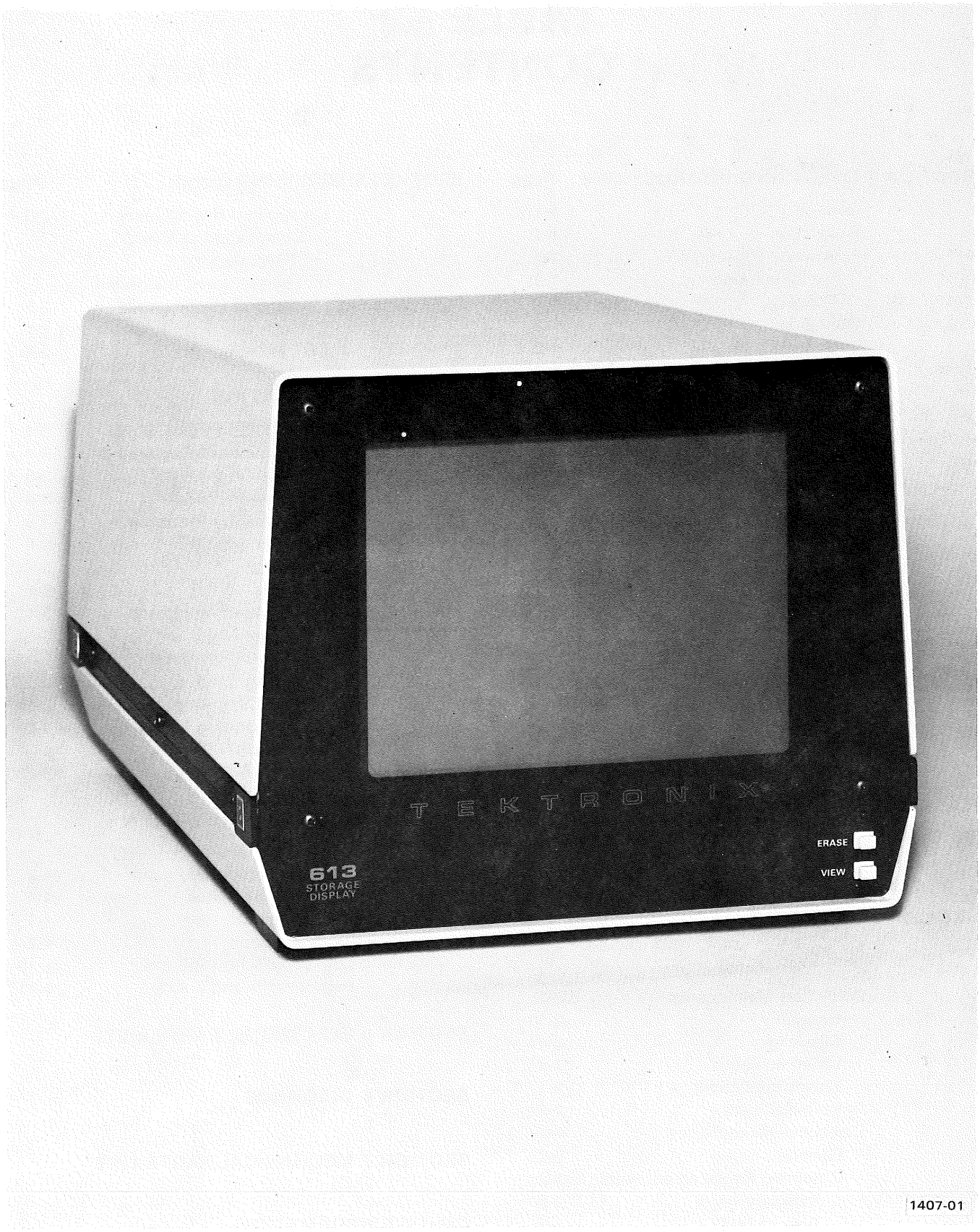


Fig. 1-1. 613 Storage Display Unit.

Section 1
OPERATING INSTRUCTIONS

General

The 613 is a Storage Display unit, featuring a Tektronix flat-faced direct-view storage cathode-ray tube. The crt has a diagonal dimension of 11 inches (15 cm X 20 cm quality viewing area). In the standard 613 configuration, the long dimension of the rectangular display screen is horizontal. As an option, the instrument can be ordered with the long-axis vertical; in that configuration, the instrument is identified as a 613-1. All references in this manual pertain to both the 613 and 613-1 except as noted.

The 613 finds its primary application as the display unit for a system where there is a requirement for a great deal of alphanumeric and/or graphic data to be displayed simultaneously and without flicker. It is often used in remote terminal stations for digital computers and other data transmission systems.

INSTALLATION

Power Connections

The 613 is provided with an attached three-wire power cord with a three-terminal polarized plug for connection to the power source. The grounding terminal of the plug is directly connected to the instrument frame as recommended by national and international safety codes. Color coding of cord conductors follows the National Electrical Code (ANSI C-1, 1968) that specifies Line, Black; Neutral, White; Safety Earth or Ground, Green with Yellow Stripe (or solid Green).

CAUTION

This instrument is intended to be operated from a single-phase power source that has one of its current-carrying conductors (the neutral conductor) at ground (earth) potential. Operation from other power sources where both current-carrying conductors are live with respect to ground (such as phase-to-phase on a multi-phase system, or across the legs of a 117-234 V single-phase three-wire system) is not recommended, as only the Line Conductor has over-current (fuse) protection within the instrument.

NOTE

The power cord on Tektronix instruments may conform to either of the following two electrical codes:

Conductor	*USA (NEC) & Canada*	*IEC*
Line	*Black*	*Brown*
Neutral	*White*	*Light Blue**
Safety Earth	*Green w/yellow stripe*	*Green w/yellow stripe*

**Tinned copper conductor.*

The 613 is normally wired at the factory for operation from a 115-volt, 60 Hz ac line voltage supply. However, it can be made to operate from any one of six different line voltages by changing some internal jumper connections.

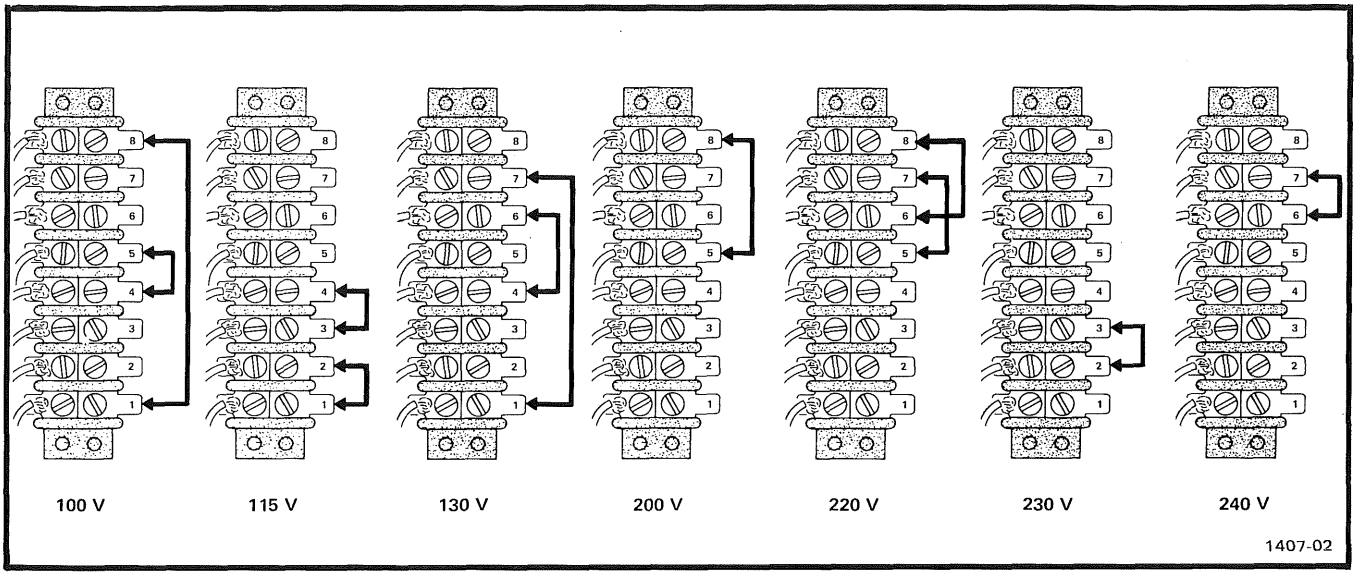


Fig. 1-2. Jumper combinations for different line voltages.

Access to these connections is obtained by removing the dust cover. To remove the cover, it is necessary first to remove the three screws found on the dark-colored feature strip along each side of the cabinet (six screws in all). Then the dust cover can be lifted off and set aside. The terminal strip containing the line voltage connectors is found at the lower right rear of the instrument. Fig. 1-2 shows the jumper combinations for each of the six line voltages.

Rack Mounting

The standard 613 is shipped from the factory in a free-standing desk-top configuration. If you plan a rackmounted installation, your Tektronix Field Engineer can supply complete details.

Cooling

The 613 is cooled by convection, and does not contain a fan. The back of the cabinet is equipped with a heat sink for more efficient cooling. At least 3 inches clearance at the rear, and 2 inches at the sides and top must be provided to allow the air to circulate freely around the instrument. If for any reason the air circulation is obstructed, the internal temperatures can exceed a safe operating level in a relatively short period of time. The maximum ambient temperature at which the instrument can be safely operated is approximately 122° F (50° C). If this temperature is exceeded, a thermal cutout switch interrupts line power to the instrument.

OPERATION

General

The display screen of the 613 is a STORAGE Cathode-Ray Tube (crt). This means that data needs only to be written a single time on the face of the tube, and the storage characteristic of the tube causes the written information to be retained for a considerable period of time. This is in contrast to a REFRESHED, or Television-type tube, where continuous repetition of the writing process is required to maintain a display on the crt. The use of a storage crt permits simplified operation of the unit while giving a stable, flicker-free, high-density display.

To prepare the 613 for normal operation, connect the X, Y, and Z-axis signal sources to the rear-panel BNC connectors. Allow the instrument to warm up for approximately 1 minute, and then push the ERASE button once.

When the preparation procedure for normal operation is completed, the instrument will be in a ready-to-write state and a display may be produced and stored by the application of appropriate X, Y, and Z-axis signals.

CAUTION

The display screen can be permanently damaged if the intensity is set too high. Refer to the INTENSITY information under Controls and Connectors.

When a display is stored, it will remain at its normal viewing intensity for about 90 seconds after the VIEW pushbutton is pushed or the last Z-axis signal is applied. It then becomes very faint (HOLD MODE), to the point that it may not be distinguished from the background areas. When the display changes and appears to be reduced in intensity, the instrument has automatically shifted to a holding mode of operation.

Hold Mode. An operating feature designed to prolong the useful life of the 613 crt is the "Hold" mode. When data has been stored on the display screen, it remains in a bright condition for approximately 90 seconds after the last data entry. Then the screen automatically reverts to a Hold Mode, in which the data remains stored on the screen, but at a level too low for direct viewing. It remains in this condition until more data is written, the VIEW button is pressed, or the screen is erased. When the 613 receives an erase command, it comes out of the Hold Mode, erases, and then immediately drops back into the Hold Mode. The Hold Mode can be over-ridden by dropping VIEW (on the Signal Interface Connector, J701) to a "low" TTL level.

View Mode. The instrument is returned to the View Mode of the operation from the Hold Mode by any of three means: with the front-panel VIEW switch; by a remote View switch; or by the application of a Z-axis turn-on signal. If the front-panel VIEW switch is used, the instrument will remain in the View Mode for about 90 seconds, then automatically revert to the Hold Mode. If a remote View switch is used, the instrument will remain in the View Mode only while the remote View switch is closed (ground closure) and return to the Hold Mode when the switch is opened (after an approximate 90-second delay). If a Z-axis turn-on signal is applied, the instrument will shift to, and remain in, the View Mode for about 90 seconds, then automatically return to the Hold Mode. (The Z-axis turn-on signal is used to add new information to a stored display while the instrument is in the Hold or View Mode.)

Erase Mode. Erasure of stored displays is accomplished with either the front-panel ERASE button or with a remote Erase command, whether the instrument is in the View or the Hold Mode of operation. An erase cycle usually requires about 0.95 second, and at the completion of the cycle the instrument is returned to a ready-to-write state.

Non-Store Operation. The 613 will assume a non-storage mode of operation with the application of a "low"

TTL level or ground potential to pin 6 of the rear-panel access plug (J701). (This is accomplished by setting remote Non-Store to On.) In a non-store configuration, the 613 may be used as a conventional crt display unit for repetitive waveforms.

Controls and Connectors

Front Panel. The front panel contains only two pushbutton controls and a red pilot light. The light glows to indicate that power is applied to the instrument. The controls are:

ERASE. Pushbutton switch. Pressing ERASE causes any displayed information to be removed from the screen.

VIEW. Pushbutton located immediately below ERASE. When the display is in Hold Mode, pressing VIEW will cause the display to return to the viewing level, and remain at the viewing level for approximately 90 seconds before returning again to Hold.

Rear Panel. Fig. 1-3 shows the rear panel, and the locations of the various controls and connectors to be found there.

INTENSITY. A rotary control, which turns the writing beam current to a level that determines whether a spot on the display screen stores. In the non-store mode, it determines the beam brightness. Since the crt screen is easily "burned" (permanently damaged by a too-bright display left on too long), the INTENSITY control should be kept at the minimum level for a visible display until such time as the 613 is operating normally within the system. When the 613 is so operating, the INTENSITY

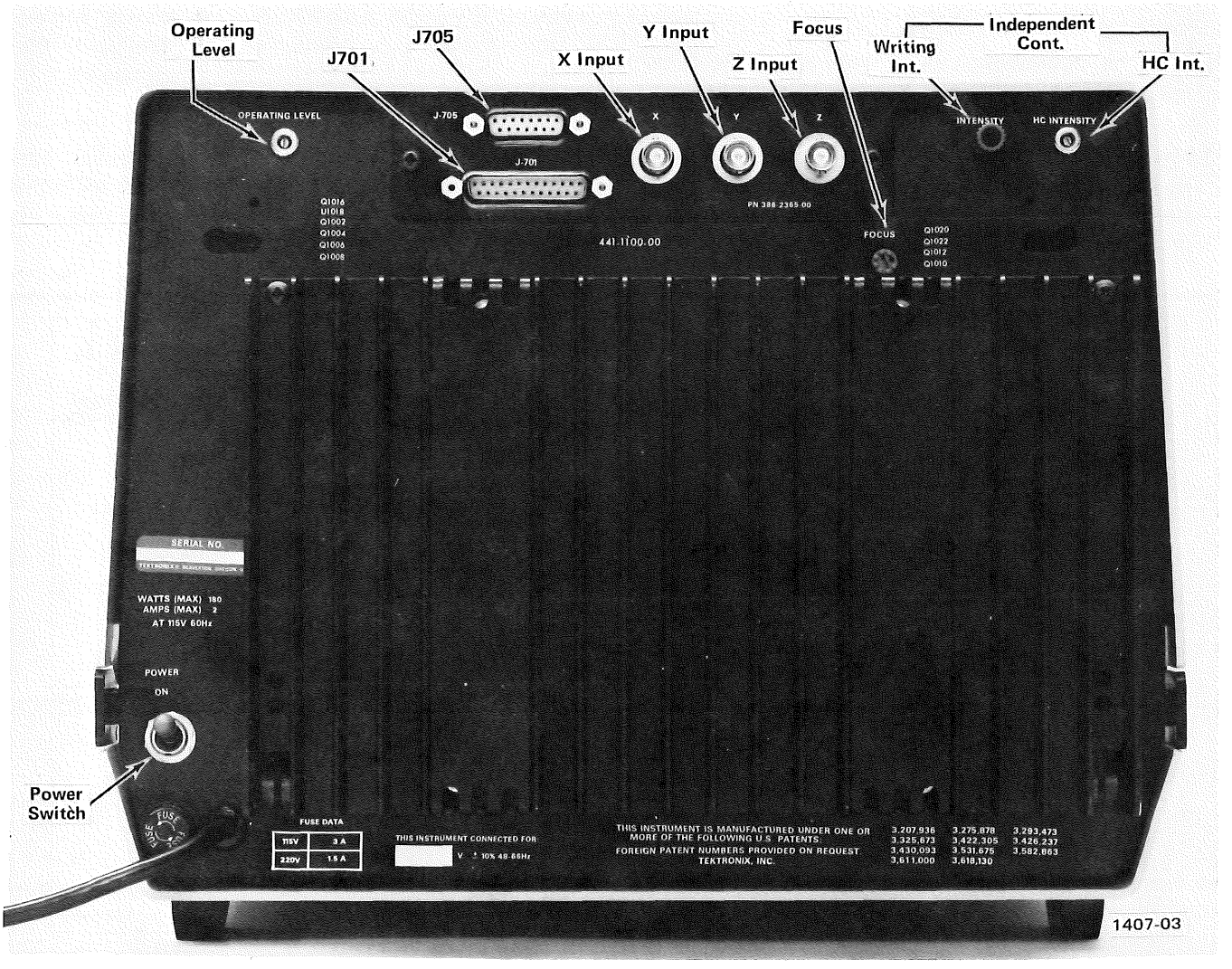


Fig. 1-3. Rear panel controls and connectors.

should be set for the viewing level that gives the sharpest definition and left there for most normal applications (clockwise for a high intensity level; counterclockwise for a lower intensity level).

HC INT. Hard Copy Intensity—A screwdriver adjustment located adjacent to INTENSITY (refer to Calibration for adjustment procedure). This control sets the intensity level of the scanning beam during the hard-copy function only, and is independent of INTENSITY.

FOCUS. A rotary control located just below INTENSITY. Properly adjusted, it sets the beam width to an optimum setting for the best display resolution.

OPERATING LEVEL. A screwdriver adjustment at the upper left corner of the rear panel. It sets the crt storage target back-plate to the proper voltage level for storage operation. For details of its adjustment, see the Adjustment Procedure, Section 3.

POWER. A toggle switch at the lower left corner of the rear panel that controls ac line power to the 613.

Connectors X, Y, and Z. Three BNC connectors located on the connector plate on the rear panel above the heat sink. The input signals to the X (horizontal), Y (vertical), and Z amplifiers are fed into these connectors.

Hard Copy Connector. A 15-contact socket (J705) located to the left of the X, Y, and Z connectors on the connector plate. This connector provides an interface for signals from the 4610 (or 4610 Option 1) Hard Copy Unit and vice versa, to permit the making of hard copies of 613 displays.

Signal Interface Connector. A 25-contact socket (J701) located immediately below the Hard Copy Connector on the 613 rear panel. The X, Y, and Z-input signals, and the signals for the remote control of the 613 operating functions are applied through this connector.

Internal Connections (Fig. 1-4)

ORIGIN LOCATION JUMPERS J9-J10. These two "harmonica" connectors select the undeflected horizontal and vertical position of the writing beam (see Fig. 1-5).

HARD COPY BUSY JUMPER J24. "Harmonica" connector in the H C Busy position causes signal BUSY to be true when the 613 display is being hard copied.

DEFLECTION BUSY JUMPER J26. "Harmonica" connector in the Deflection Busy position causes signal BUSY to be true when the 613 deflection system is not settled.

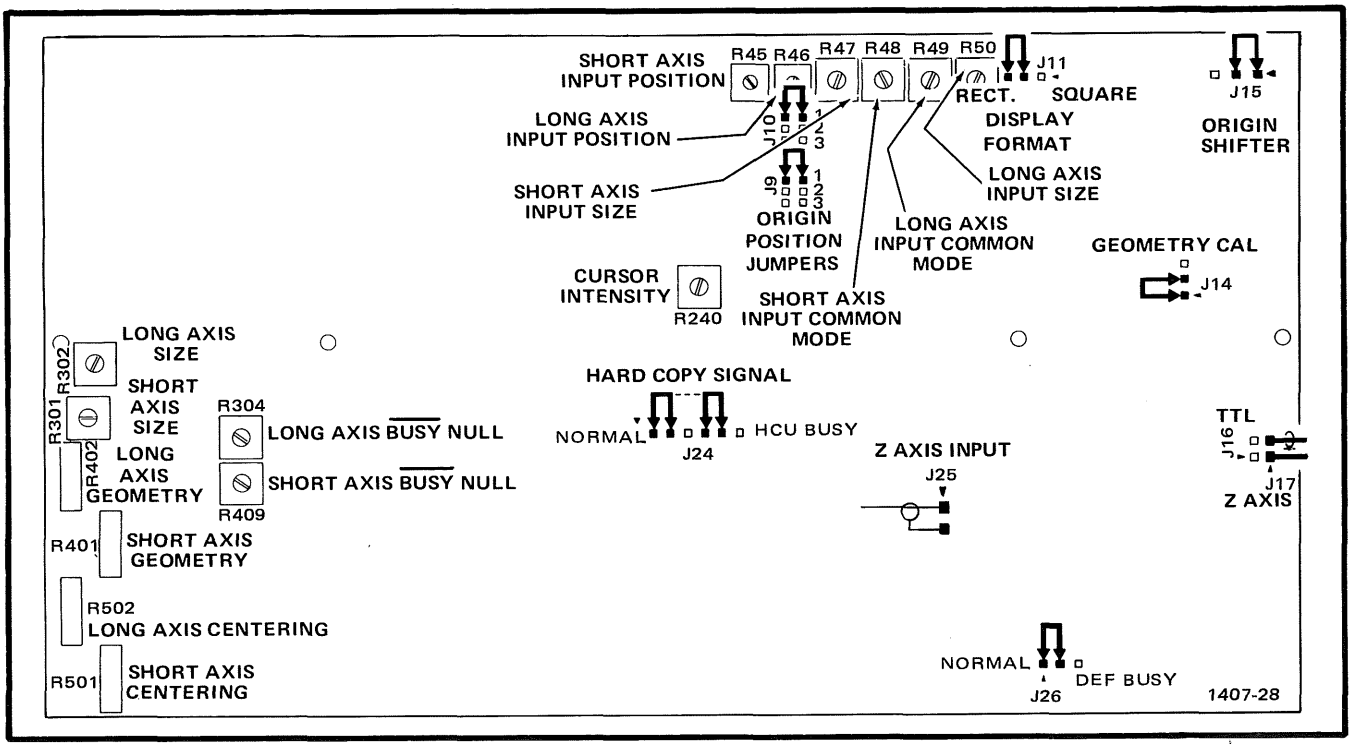
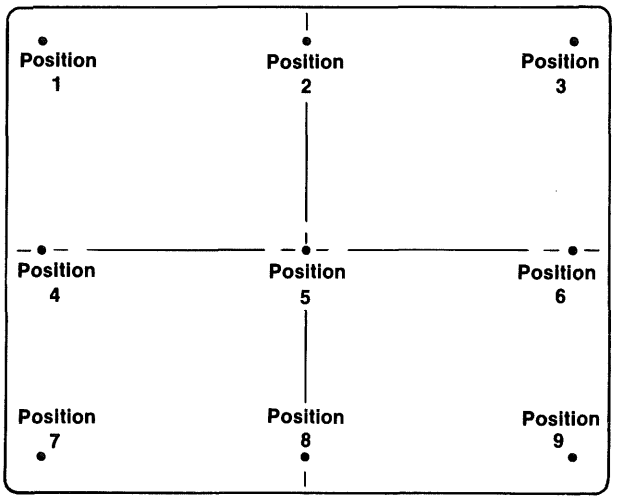
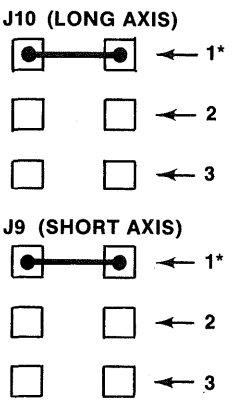


Fig. 1-4. Internal connection options located on the Deflection Amplifier Board. The 613 is shipped from the factory with the jumpers wired as shown above.



WRITING BEAM ORIGIN POSITION (shown at left)	JUMPER POSITIONS (shown at right) 613 J10 J9 / 613-1 J9 J10
1	1 3
2	2 3
3	3 3
4	1 2
5	2 2
6	3 2
7*	1 1
8	2 1
9	3 1



*Factory-connected position

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Fig. 1-5. Writing beam origin positions and the related jumper positions on the Deflection Amplifier board.

RECTANGULAR-SQUARE FORMAT J11. Fig. 1-4 shows the J11 jumper connected across pins 2 and 3, the normal connection for a rectangular (15 X 20 cm) display format. In the 613-1, pins 1 and 2 of J11 are normally connected to provide a square (15 X 15 cm) display format.

GEOMETRY CALIBRATE J14. As shown in Fig. 1-4, the J14 jumper is always connected across pins 1 and 2, except when Geometry is being adjusted as described in Section 3 Calibration, Step 11e.

Z AXIS SELECTOR (Coaxial Cable). With the coaxial cable connected as shown (to J17) in Fig. 1-4, Z-axis input is normal (a one-volt signal turns on the Z-axis Amplifier, and a 0.5-volt signal turns it off). In the TTL (alternate) position (J16), a TTL-logic low level enables the Z-axis Amplifier, and a TTL high shuts it off.

ORIGIN SHIFTER J15. Connected to pins 1 and 2 as shown in Fig. 1-4, the Origin Shifter moves the display trace origin in one-point increments on successive erasures. Disable during calibration by connecting to pins 2 and 3.

CONTROL SIGNALS

In the typical system configuration in which the 613 is used, the X, Y, and Z inputs and the control functions of the instrument are commanded by remote signals. These commands enter at the rear-panel Signal Interface Control, J701. Fig. 1-6 shows the pin locations of these signals, as well as the incoming and outgoing signals applied to J705, the Hard Copy Connector, when a 4610 or 4610 Option 1 Hard Copy Unit is connected. Further descriptions of the control signals follow.

Signal Interface Connector, J701

$\overline{\text{Erase}}$ Pin 18. A TTL "low" signal causes the display to be erased.

$\overline{\text{Non-Store}}$ Pin 6. A TTL "low" signal places the 613 crt in a "non-store" mode. A repetitive input to the X, Y, and Z amplifiers is required to produce a continuous display.

$\overline{\text{Cursor}}$ Pin 8. When a remote TTL "low" is applied, the crt stops reacting in the normal way to a Z-amplifier input pulse. Instead, the writing beam is duty-cycle controlled at a low repetition rate and moved in a square 8 X 8 dot matrix pattern to produce a non-storing, square cursor. This cursor is provided so that the beam position can be visually located, without additional information being stored, or existing information destroyed. The 613 cursor does not have a write-thru operating mode.

$\overline{\text{View}}$ Pin 20. When the 613 is in Hold Mode and a remote TTL "low" is applied, the instrument will switch to the View Mode and remain in that mode until the "view" signal goes to a TTL "high".

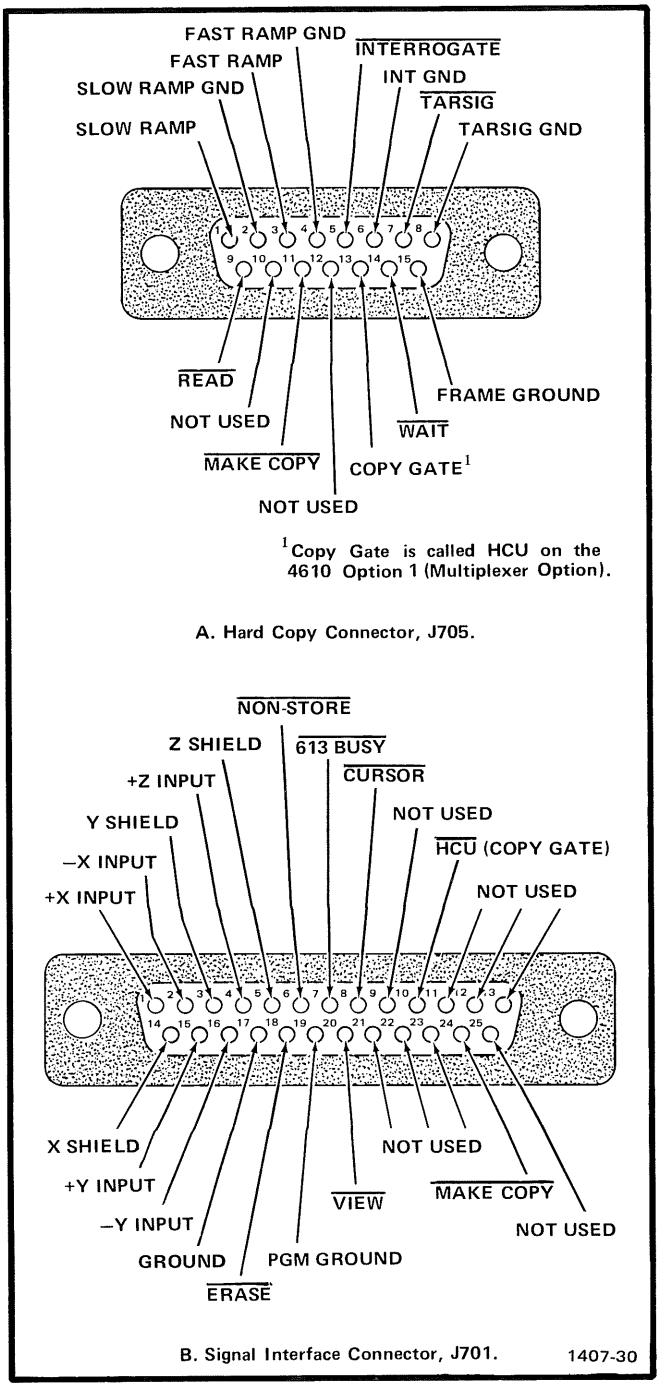


Fig. 1-6. Pin configurations of (A) The Hard Copy Connector and (B) the Signal Interface Connector. (Illustrated from wired side of connectors.)

613 Busy Pin 7. A TTL "low" is present at this contact any time the 613 is in an erase interval, a hard copy is being made, or the 613 is in its settling time delay period. These last two functions are internal jumper options (see Fig. 1-4). The signal is used to notify associated equipment, such as a computer, that the 613 is in one of the above-named states.

Make Copy Pin 24. If a 4610 Hard Copy Unit is connected to J705, a TTL "low" at this terminal commands the Hard Copy Unit to make a copy of the display.

Program Ground Pin 19. This is the ground reference for the remotely-connected external functions.

Hard Copy Connector, J705

The Hard Copy Connector provides interface between the 613 and the 4610 (or 4610 Option 1) Hard Copy Unit for control signals having to do with the making of hard copies of the 613 display. Fig. 1-6 illustrates the pin configuration of J705. Further description of the signals is provided below.

Slow Ramp Pins 1 & 2. The Slow Ramp signal is furnished by the Hard Copy Unit to the 613 to provide a vertical scanning signal on the 613 Display Unit (horizontal scanning signal on the 613-1).

Fast Ramp Pins 3 & 4. The Fast Ramp signal is furnished by the Hard Copy Unit to provide a horizontal scanning signal to the 613 Display Unit (vertical scanning signal on the 613-1).

Interrogate Pins 5 & 6. Interrogation pulses are supplied by the Hard Copy Unit to drive the Z-axis of the Display Unit during the hard-copy process.

Tarsig Pins 7 & 8. Signals are sent from the target amplifier in the 613 to the Hard Copy Unit at any time when a hard copy is being made.

Read Pin 9. When the copy command is given, Read is sent to the 613 to switch it to the Hard Copy Mode.

Make Copy Pin 11. A signal supplied to the Hard Copy Unit (from J701 to J705) to initiate the making of a copy.

Copy Gate Pin 13. In the 4610, this signal is supplied to indicate that the Hard Copy Unit is busy. In the 4610 Option 1, this signal is called HCU, and it is always in the low state when the Hard Copy Unit power is On.

Wait Pin 14. This signal is used only with the 4610 Option 1. In the Hard Copy Unit Multiplexer Option, Wait is held in the low state at all times except when Read is high.

Pin 15. Frame ground.

Pins 10 & 12. Not used.

Remote Program Inputs

The functions and operating modes of the 613 are as follows: Erase, View, Non-Store, and Cursor. These modes may be controlled from a remote station by applying appropriate ground closures through the rear-panel Signal Interface Connector, J701 (see Fig. 1-6).

If desired, the Signal Interface Connector may be used to apply X, Y, and Z signals to the instrument. Fig. 1-6 shows the pins that are normally reserved for this option. To maintain the input capacitance specification of the instrument when altering the wiring, use the internal coaxial cables by disconnecting the cables from the X, Y, and Z BNC connectors and reconnecting these same cables to the appropriate pins.

Operating Precautions

To prolong the useful life of the crt, observe the following precautions when operating the 613.

1. Adjust the INTENSITY control for the lowest (counterclockwise) setting that will produce a clear, well-defined display. Excessive intensity may cause either a bright-burn condition or, if intense enough, a more serious dark-burn condition.

A bright-burn condition is when a light image of the display remains on the screen after erasure. Refer to the Maintenance section for instructions on how to cure a bright-burn condition.

A dark-burn condition is the destruction of the phosphor on the crt by too much beam current. This condition is evidenced by a spot or area on the screen that will not react to the writing gun (remains dark and cannot be illuminated). As with a conventional crt, the only remedy for this condition is replacement of the crt, unless an adequate portion of the screen remains usable.

2. Erase the display when the information is no longer needed. If a display is left on the crt too long, the crt can cause a residual image to appear. The brightness level of the image phosphor as compared to the brightness level of the new display's background phosphor will determine whether the image appears as positive or negative. The residual image can be erased by establishing a fade-positive condition (refer to the Maintenance section).

SPECIFICATIONS

General

The electrical performance characteristics specified in this section are valid under the following conditions.

1. The instrument must have been calibrated at an ambient temperature range between +68° F and +86° F (+20° C and +30° C).

2. The instrument must be operated in an ambient temperature environment as described under Cooling in this section.

3. There must be a warm-up period of at least 20 minutes.

TABLE 1-1

ELECTRICAL

Characteristic	Requirement	Supplemental
VERTICAL AND HORIZONTAL DEFLECTION		
Input Requirements		
Deflection		
Horizontal (20 cm full screen)	1 V/15 cm in square format	Internal gain adjustment permits 15% additional range
	1 V/20 cm in rectangular format	
	Within 2% of full screen deflection (referred to center screen)	
Vertical (15 cm full screen)	1 V/15 cm within 2% of full screen deflection (referred to center screen)	
Sense	+ vertical input moves beam upwards	
	+ horizontal input moves beam to the right	
Maximum Input Voltage	±18 V dc plus peak ac	
Input R and C	20 kΩ minimum and 60 pF maximum	
Signal Beam Origin Position	Shipped with jumpers set for position 7 (origin in lower left corner)	See Fig. 1-5
Position Stability (0°C to +50°C)	5 mm maximum	
Beam Settling Time	(to within 0.025 cm) 14 μs + 6 μs/cm for a spot movement up to 2 cm; 3 μs/cm for movements beyond 2 cm	
Z AXIS		
Input Requirements		
Turn Beam On	At least +1 V	
Turn Beam Off	+0.5 V or less	
Maximum Input Voltage	±20 V dc plus peak ac	

TABLE 1-1 (cont)

Characteristic	Requirement	Supplemental
Input R and C	10 kΩ, ±10%, shunted by approximately 50 pF	
TTL ($\overline{\text{Z AXIS}}$) Maximum Input	+5 V	Equivalent to 2 TTL loads
Turn Beam On	A TTL low level	
Turn Beam Off	A TTL high level	
CRT		
Type	Bistable storage	
Phosphor	P1	
Storage Capacity	25% incremental in quality area	
Quality Area		
Horizontal	20 cm	
Vertical	15 cm	
Stored Resolution	200 x 266 line pairs	
DISPLAY		
Linearity		
Full Scale	Within 1-1/2% along center axis (spot will settle within 1-1/2% of proper position for voltage applied)	
Incremental	No more than 15% difference in spacing over any 2 cm interval in both axes	
Viewing Time	15 minutes or less recommended for specified resolution	View Mode timer causes display to enter Hold Mode 90 to 120 seconds after VIEW switch is actuated
Orthogonality	90 degrees, ±1 degree	
Line Straightness (deviation from mean straight line)	0.5% or less of line length	
Erase Time	≈0.9 second	
Dot Writing Time	5 μs or less at specified resolution	

TABLE 1-1 (cont)

Characteristic	Requirement	Supplemental
POWER REQUIREMENTS		
Line Voltage Ranges		
Low	100 V, ±10% 200 V, ±10% 220 V, ±10%	
Medium	115 V, ±10% 230 V, ±10%	
High	120 V, ±10% 240 V, ±10%	
Power Consumption (at 115 V 60 Hz)	180 W maximum	
Line Fuse		3 A fast blowing type for 115 V operation 1.5 A fast blowing type for 220 V operation
Internal Fuses		
+25 V		3 A fast blowing type
−25 V		2 A fast blowing type
Deflection		1 A fast blowing type for each deflection axis (mounted on Deflection etched-circuit board)

TABLE 1-2

ENVIRONMENTAL

Characteristic	Requirement	Supplement
Temperature		
Non-Operating	−40°C to +65°C	
Operating	0° to 50°C (at sea level)	
Specified Operation Range	25°C, ±10°C (at sea level)	
Altitude		
Non-Operating	To approximately 50,000 ft.	
Operating	To approximately 15,000 ft.	
Transportation		Qualified under NSTC test procedure 1A, category II (24 inch drop)

TABLE 1-3

PHYSICAL

Characteristic	Requirement	Supplemental
Dimensions		
Height		Approximately 11 inches (approximately 28 centimeters)
Width		Approximately 13 inches (approximately 34 centimeters)
Depth		Approximately 21 inches (approximately 53 centimeters)
Weight		
Net		Approximately 43 pounds (approximately 19.5 kilograms)
Shipping		Approximately 55 pounds (approximately 25 kilograms)

Section 2
SERVICING

Introduction

This section of the manual contains maintenance information for use in preventive and corrective maintenance.

Cover Removal

The top cover of the instrument is held in place by six screws. To remove the cover, remove the screws and lift the cover off the instrument. The cover protects the instrument from getting dust in the interior, and provides proper airflow for cooling.

WARNING

Dangerous potentials exist at several points throughout this instrument. When the 613 is operated with the cover removed, do not touch exposed connections or components. Some transistors have elevated cases. Disconnect power before cleaning the instrument or replacing parts.

PREVENTIVE MAINTENANCE

General

Preventive maintenance consists of cleaning, visual inspection, lubrication, etc. Preventive maintenance performed on a regular basis reduces instrument-down time. The severity of the environment to which the instrument is subjected determines the frequency of maintenance. A convenient time to perform preventive maintenance is preceding re-adjustment.

Cleaning

General. The 613 should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on the components acts as an insulating blanket and prevents efficient heat dissipation. It also provides electrical conduction paths that may result in instrument failure.

The cover provides protection against dust in the interior of the instrument. Operation without covers in place necessitates more frequent cleaning.

CAUTION

Avoid the use of chemical cleaning agents that might damage the plastics used in this instrument. Avoid chemicals that contain benzene, toluene, xylene, acetone or similar solvents.

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

Interior. Dust in the interior of the 613 should be removed occasionally due to its electrical conductivity under high-humidity conditions. The best way to clean the interior is to blow off the accumulated dust with dry, low-pressure air. Remove any dirt that remains with a soft paint brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces or for cleaning circuit cards.

The high-voltage circuits, particularly parts located in the high-voltage compartment, should receive special attention. Excessive dirt in this area may cause high-voltage arcing and result in improper instrument operation.

Visual Inspection

The 613 should be inspected occasionally for such defects as broken connections, improperly seated transistors, damaged circuit boards and heat-damaged parts.

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.

Transistor Checks

Periodic checks of the transistors are not recommended. The best check of the transistor performance is actual operation in the instrument.

Re-adjustment

To ensure acceptable performance, check the adjustment of this instrument after each 1000 hours of operation or every six months if used infrequently. Any time components are replaced, recalibration of the affected circuits may be necessary. Complete adjustment instructions are given in the Calibration section

The adjustment procedure can also be helpful in localizing certain troubles in the instrument. In some cases, minor troubles may be revealed and/or corrected by readjustment.

CORRECTIVE MAINTENANCE

General

Corrective maintenance consists of component replacement and instrument repair. Special techniques required to replace components in this instrument are given here.

Obtaining Replacement Parts

Standard Parts. All electrical and mechanical parts replacements can be obtained through your local Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before purchasing or ordering replacement parts, check the parts lists for value, tolerance, rating and description.

NOTE

When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect its performance in the instrument, particularly at high frequencies. All replacement parts should be direct replacements, unless it is known that a different component will not adversely affect instrument performance.

Special Parts. In addition to the standard electronic components, some special components are used. 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. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your local Tektronix Field Office or representative.

Component Replacement

WARNING

Disconnect the instrument from the power source before replacing components.

Circuit Card or Board Replacement. If a circuit board is damaged beyond repair, the entire assembly including all soldered-on components must be replaced. Part numbers are given in the Mechanical Parts List for the completely wired boards.

Transistor and Integrated Circuit Replacement. Transistors and Integrated Circuits should not be replaced unless actually defective. If removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement of transistors or IC's may affect the calibration of this instrument. When transistors or IC's are replaced, check the operation of the parts of the instrument that may be affected.

Replacement transistors or IC's should be of the original type or a direct replacement. Fig. 2-1 shows the lead configuration of the transistors and IC's used in this instrument. If a transistor is replaced by another transistor made by a different manufacturer than the original, check the manufacturer's basing diagram for correct basing. Transistors that have heat radiators (or are mounted on the chassis) use silicone grease to increase heat transfer. Replace the silicone grease when replacing these transistors.

WARNING

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

Cathode Ray Tube Replacement

WARNING

The crt may implode if it is scratched or struck severely enough. Wear protective clothing and a face shield when replacing the crt.

To remove the cathode ray tube, use the following procedure:

1. Disconnect the signal cables.

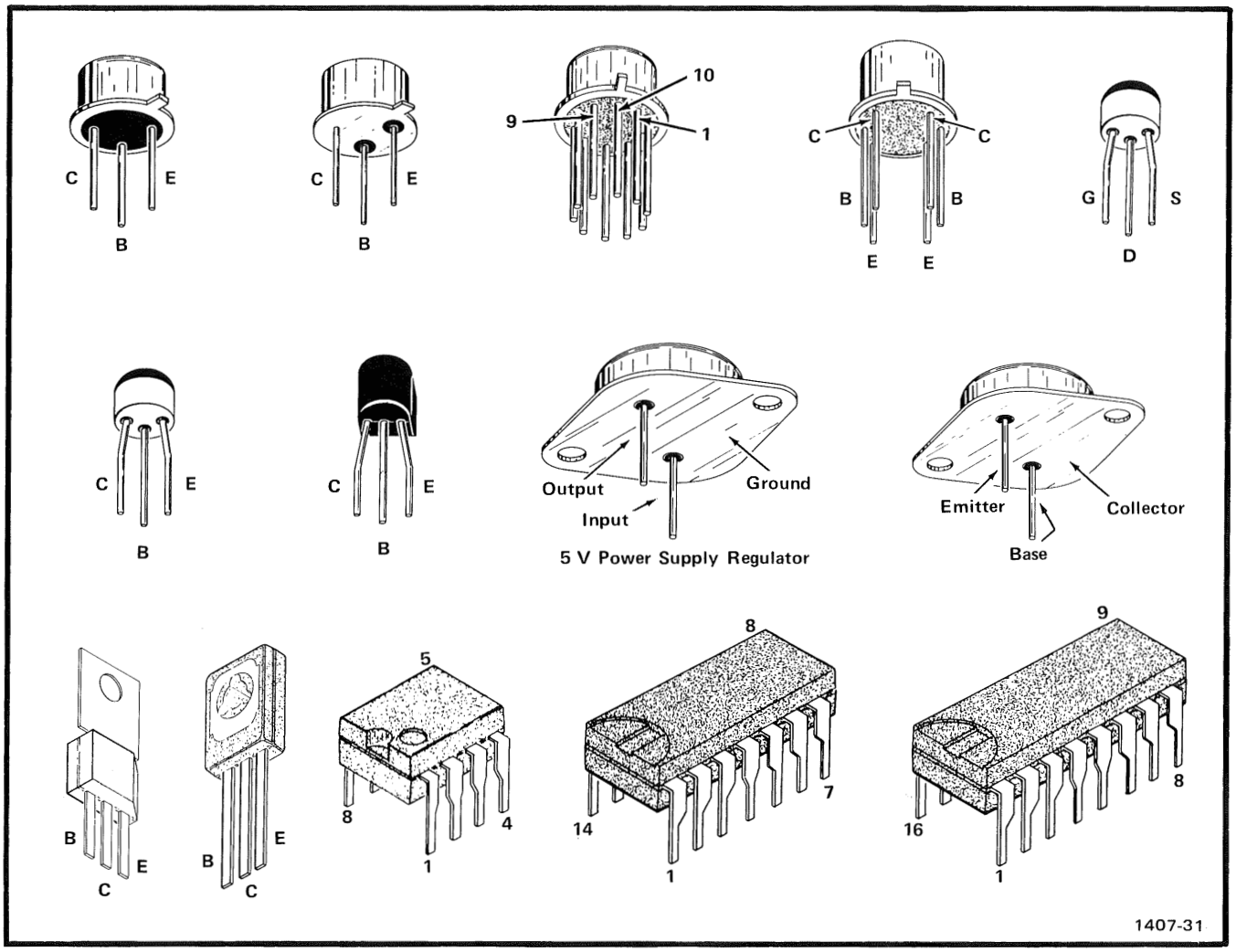


Fig. 2-1. Lead configurations of transistors and integrated circuits in the 613.

2. Disconnect the power cord from the source.

3. Remove the top dust cover.

4. Remove the top two screws holding the heat sink to the rear panel. Swing the heat sink out and down to obtain access to the crt base socket.

5. Disconnect the crt base socket by pulling the socket straight back.

6. Disconnect storage plug J20 from the Hard Copy Amplifier board.

7. Remove the four screws that hold the green light filter to the instrument. Disconnect the two-pin connector from the red pilot light and remove the filter.

8. Remove the electro-magnetic interference (emi) shield brackets and the emi shield.

9. Remove the four nuts, spacers and the implosion shield frame (see Fig. 2-2).

10. Pull the crt straight forward from the unit. Support the crt neck when removing the crt cable and plug.

11. With the crt out of the unit, remove the rubber gasket.

12. Protect the crt from damage while it is out of the unit by placing it face down on the soft mat, or (preferably) by placing it in a crt shipping carton.

To install a crt in the 613, use the following procedure:

1. Place the rubber gasket on the crt faceplate. The rubber gasket must be correctly installed to prevent its front holding lip from rolling back and causing a bind when installing the unit.

2. Partially insert the crt into the unit and push the plug and cable through the access hole in the shield, then guide the crt neck into the yoke and push the crt all the way into the unit. Do not allow stress on the crt neck.

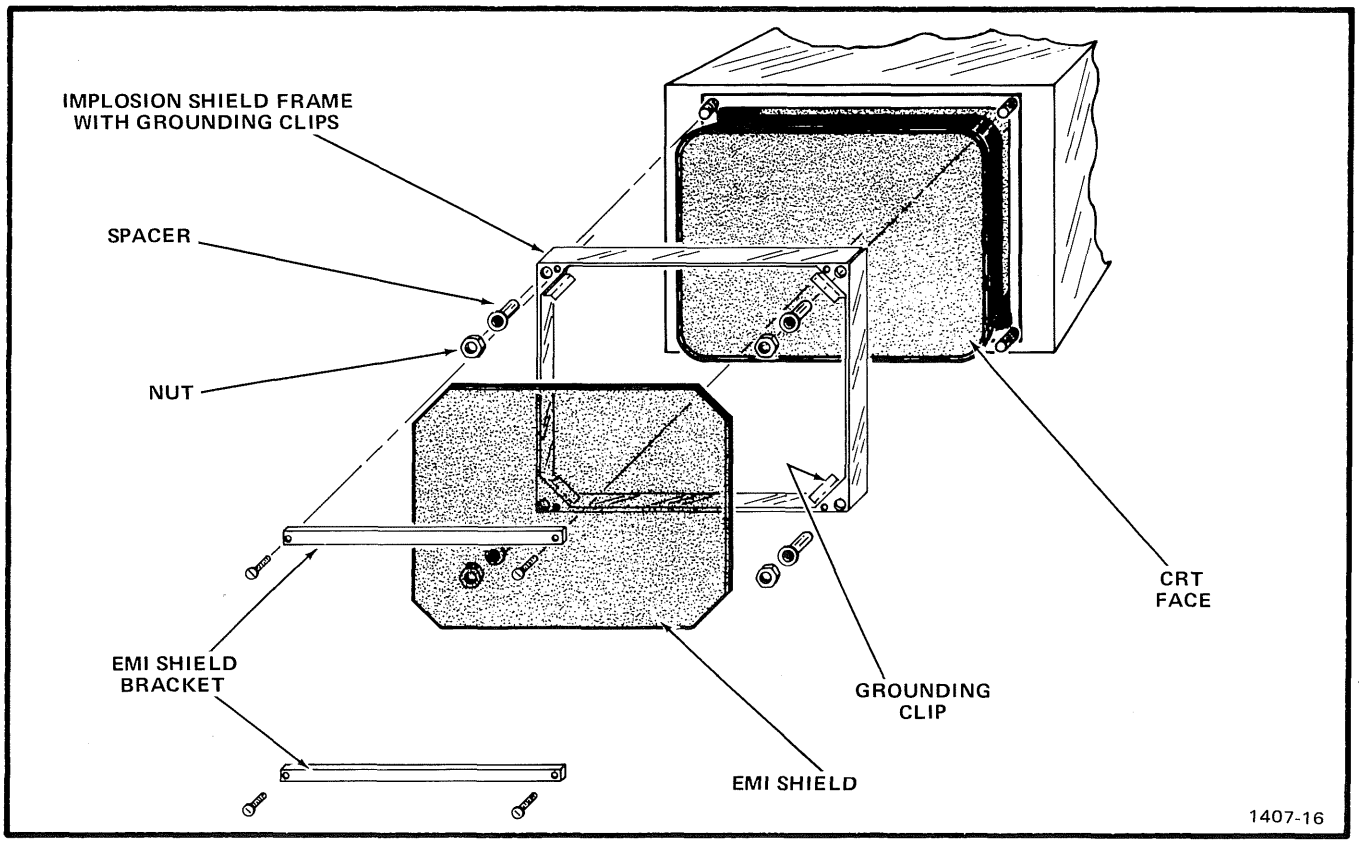


Fig. 2-2. Locations of crt securing hardware.

3. Reinstall the implosion shield frame, spacers and nuts.

4. Connect the base socket to the crt base.

5. Insert and tighten the screws securing the heat sink against the rear panel. Align the trace as described in Section 3 Calibration.

6. Install the emi Shield with the silver ring toward the crt faceplate. Replace the front panel and red pilot light connector. If the pilot light will not light when the 613 is turned on, (uses a LED as an indicator) reverse the indicator connector.

7. After the installation of the crt, it may be necessary to calibrate the instrument and reposition the yoke. These procedures are given in Section 3.

NOTE

The crt shield and crt neck shield are fabricated from a metal that protects the crt yoke and electron trajectories from external magnetic interference. Since a sharp blow may cause the shield to lose some of its protective properties, handle it carefully. If the shield is damaged and a loss of shielding occurs, contact your local Tektronix, Inc. Field Office or representative for assistance.

CRT Phosphor Burns

A bright-burn condition is when a faint image (residual image) of the display remains on the screen after erasure. Bright-burn images can be erased by adjusting the OPERATING LEVEL control to bring the entire screen up to the brightness level of the residual image (fade-positive condition). The time required for a fade-positive condition to completely erase the image depends on the severity of the burn. A severe burn may require up to a 12-hour fade-positive condition for complete screen erasure. Operate the instrument in the fade-positive mode only as long as necessary, since extended fade-positive operation will decrease the life expectancy of the crt.

A dark-burn condition is the destruction of the phosphor on the crt by the intensive beam current. This condition is evidenced by a spot or area on the screen that will not react to the writing gun (remains dark and cannot be illuminated). As with a conventional crt, the only remedy for this condition is replacement of the crt.

Section 3
CALIBRATION

This section of the manual describes the adjustments that are occasionally needed to ensure continued optimum performance of the 613. Two separate procedures are provided. The first is the complete Calibration Procedure, which if carried out in its entirety, will restore instrument performance to original specifications. Considerable test equipment is required for the completion of this procedure. If such equipment is not readily available, it may be more convenient to contact your nearest Tektronix service center for the complete calibration service available there.

The second procedure is a Field Adjustment Procedure, which is designed to provide a means for reestablishing useful instrument performance after field repairs or after long periods of operation that may have caused some performance deterioration. This procedure requires only a dc voltmeter and a signal source.

References to the 613 apply equally to the 613-1 except where noted.

CALIBRATION PROCEDURE

Introduction

This procedure includes complete information about electrical adjustments needed to bring the 613 Storage Display Unit within original performance limits. This procedure, or applicable portions of it, should be performed after any major circuit repairs, or at any time when it appears that the performance of the unit may have deteriorated to any degree. In addition to instructions for a complete adjustment procedure, this section contains an abridged adjustment procedure that can serve as a check of adjustments for the experienced calibrator, and as a record of adjustments. Limits and tolerances noted are to be considered as adjustment guides, rather than as instrument specifications.

TEST EQUIPMENT REQUIRED

General

The following test equipment or its equivalent is needed for the complete adjustment procedure. Specifications given for the test equipment are the minimum necessary for accurate adjustment of the 613. All test equipment is assumed to be correctly calibrated, and operating within the given specifications. If equipment is substituted, it must meet or exceed the specifications of the recommended equipment.

A Tektronix 4610 Hard Copy Unit is listed as an optional item of test equipment. If your 613 is used regularly to produce hard copies of displayed information, the 4610 must be used in calibrating the Display Unit if optimum quality hard copies are to be produced consistently.

Equipment List

1. Precision DC Voltmeter. Accuracy, within ±0.5%. Range 0 to 6 kV. For example, Fluke Model 8100B Digital Voltmeter. (A Fluke voltage divider must be used with the voltmeter to measure voltages about 1000 V.)

2. Test Oscilloscope. Bandwidth dc to at least 20 MHz, minimum deflection factor .005 volt/div. Must have both alternate vertical channel display and differential comparator capabilities, and must supply a sweep output signal of 10 V. For example, Tektronix 485 Oscilloscope, with two 10X and one 1X probes.

3. Test Display Generator. Must be capable of generating a raster of approximately 16 to 24 line pairs and a 200 by 266 dot raster. The raster output amplitude should be approximately 1 V. The unblanking Z-axis output must be adjustable from 0.5 V to 1 V. Tektronix Calibration Fixture 067-0561-01 is recommended.

A modified 067-0561-00 Test Display Generator may be used. To modify, remove diodes D252, D254, D256 and D258. Replace the diodes with wire straps. The diodes are

located on the bottom side of the circuit board, in the extreme right front corner, next to Q234. After modification, the generator will continue to be compatible with all other displays.

Always use the 067-0561-00 with the Output Signal Source switch set to INT. When the calibration procedure calls for a dot density of 200:266, set the control for 300:400 and adjust the variable control for a sawtooth duration of 9 ms at the X output BNC connector (when in the XY position) or at the Y output BNC connector (when in the YX position).

4. Variable Autotransformer. Must be capable of supplying at least 250 W over a range of 90 to 136 V (180 to 272 V for 230 V nominal line). If the autotransformer does not have an ac (rms) voltmeter to indicate output voltage, monitor output with an ac (rms) voltmeter. For example, General Radio W10MT3W Metered Variac® Autotransformer for 115 V nominal line.

5. Pulse Generator. Variable pulse amplitude, selectable polarity, variable pulse width (approximately 1 to 100 μs); risetime, 10 ns or less. Tektronix PG501 Pulse Generator is recommended which must be used in a TM500-series Power Module.

6. Time-Mark Generator. Marker outputs, 1 μs and 5 μs; marker accuracy, within 0.1%; amplitude, 1 V minimum peak into 50 Ω. Trigger output, 0.1 ms positive-going pulse, 0.4 V minimum amplitude into 50 Ω. Tektronix TG501 Time-Mark Generator is recommended which must be used in a TM500-series Power Module.

7. Standard Amplitude Calibrator. Amplitude accuracy, within 0.25%; signal amplitude, 1 V; output signal, 1 kHz square-wave, positive-going. Tektronix Calibration Fixture 067-0502-01 is recommended.

8. Tektronix 4610 Hard Copy Unit (optional).

9. Sweep Attenuator, Tektronix Part No. 067-0569-00.

10. 10X Attenuator Probes (2). Tektronix P6060 is recommended.

11. 1X Attenuator Probe. Tektronix P6011 is recommended.

12. Coaxial cables (4). Impedance 50 Ω; length, 42 inches; connectors, BNC. Tektronix Part No. 012-0057-01.

13. Patch Cord. BNC to banana plug-jack; length, 18 inches. Tektronix Part No. 012-0091-00.

14. Terminations (2): Impedance, 50 Ω; accuracy, within ±2%; connectors, BNC. Tektronix Part No. 011-0049-01.

15. 5X Attenuator. Impedance, 50 Ω; accuracy, within ±2%; connectors, BNC. Tektronix Part No. 011-0060-01.

16. 10X Attenuator. Impedance, 50 Ω; accuracy, within ±2%; connectors, BNC. Tektronix Part No. 011-0059-01.

17. Test Graticule, 1 cm division. Tektronix Part No. 067-0671-00.

18. Magnifier, Power 9X to 12X.

19. Tools:

a. Screwdriver, 3-inch shaft, 3/32-inch wide bit.

b. Alignment tool with plastic handle and shaft, metal tip. Tektronix Part No. 003-0000-00.

CALIBRATION INDEX

613, Serial No._____

Calibration Date_____

Calibrator_____

POWER SUPPLIES

1. Check/Adjust +15-Volt Supply

   +15 V ±75 mV.

2. Check Low Voltage Power Supplies

   See Table 3-1 for voltage and ripple tolerances.

3. Check Flood Gun Voltage

   Measured between TP41 and TP42, 26 V ±10%.

4. Adjust High Voltage

   −6000 V ±5%.

STORAGE

5. Adjust Collimation Voltage

   Adjust R103 for voltage noted on crt tag.

6. Adjust Operating Level

   Adjust R1010 for voltage noted on crt tag (see NOTE in Complete Procedure).

7. Check Erase Sequence

   See Complete Procedure for waveforms and test points.

Z-AXIS

8. Adjust Writing Intensity Preset

   0.5 V extinguishes display, 1 V produces display.

9. Check Z-axis Rise- and Fall-time

   Rise-time and Fall-time both 0.2 μs or less.

DEFLECTION AMPLIFIERS

10. Adjust Common Mode

    See Complete Procedure.

11. Adjust Trace Alignment and Geometry

    Adjust crt yoke. Adjust R402 (Long-axis Geom) and R401 (Short-axis Geom).

12. Adjust Main Amplifier and Preamplifier Centering and Size

    See Complete Procedure.

12. (Alternative) Adjust Main Amplifier and Preamplifier Centering and Size

    See Complete Procedure.

DISPLAY ALIGNMENT

13. Recheck Geometry, Check Display Linearity

    Line spacing linear over quality area, ±15%.

14. Check Orthogonality

    90° ±1°.

15. Adjust $\overline{\text{BUSY}}$ Null

    See Complete Procedure.

CRT

16. Adjust CRT Grid Bias

    See Complete Procedure.

17. Preset Hard Copy Intensity (without Hard Copy Unit

    See Complete Procedure.

18. Adjust Focus

    See Complete Procedure.

SETTLING TIME

19. Check Settling Time

See Complete Procedure.

20. Check View Timer

Drops into Hold Mode in 90 seconds ±30 seconds.

HARD COPY AMPLIFIER

21. Adjust Hard Copy Intensity

See Complete Procedure.

22. Adjust Cursor Intensity

See Complete Procedure.

23. Adjust Hard Copy Threshold and Dynamic Threshold

See Complete Procedure.

24. Check Origin Shifter Operation

See Complete Procedure.

25. Adjust Square Format (613-1 only)

See Complete Procedure.

26. Completion

COMPLETE PROCEDURE

In the procedure that follows, steps are grouped under major circuit headings or adjustment categories to simplify calibration of specific sections. Preceding each group of steps is a listing of all the items of test equipment required for that portion of the procedure. Control settings of test instruments are also listed preceding each group of related steps. Some steps in calibration are modified if a Hard Copy Unit is used in the procedure. These steps are listed separately. Test equipment used in this procedure is taken from the Equipment Required List at the beginning of the section. If other equipment is substituted, be sure that minimum specifications of the substitute equipment are adequate for the procedure.

NOTE

When performing a complete recalibration, best performance will be obtained if each adjustment is made to the exact prescribed setting, even if a preliminary check shows the characteristic to be within the allowable tolerance.

Preliminary Procedure

1. Remove the top dust cover from the 613 after removing the three screws from each side along the feature strip.

2. Remove the green outer light filter from the front of the instrument by removing the four Phillips-head screws holding it to the instrument frame. Use caution in removing the filter to avoid damaging the pins of the light-emitting diode that serves as a pilot light at the lower right hand corner. Disconnect the pilot light connector.

3. If the instrument is equipped with an emi shield under the green light filter, remove the shield. In either case, install the test graticule over the front of the crt.

4. Inspect the Deflection Amplifier board to check that the input connectors are correctly installed for the 613 (horizontal format), or the 613-1 (vertical format). Table 3-2 shows the connections. Check also that the various strap option jumpers are connected as shown in Fig. 3-1.

5. Check that the 613 Low Voltage Power Supply jumpers are connected for 115 V (refer to Fig. 1-2).

6. Connect the autotransformer to a suitable power source.

7. Connect the 613 power cord to the autotransformer output.

8. Set the autotransformer for 115 V output.

9. Check that the rear-panel INTENSITY control on the 613 is fully counterclockwise, then turn the 613 POWER switch on. Allow at least 20 minutes warmup at an ambient temperature of +25° C ±5°, before starting the calibration.

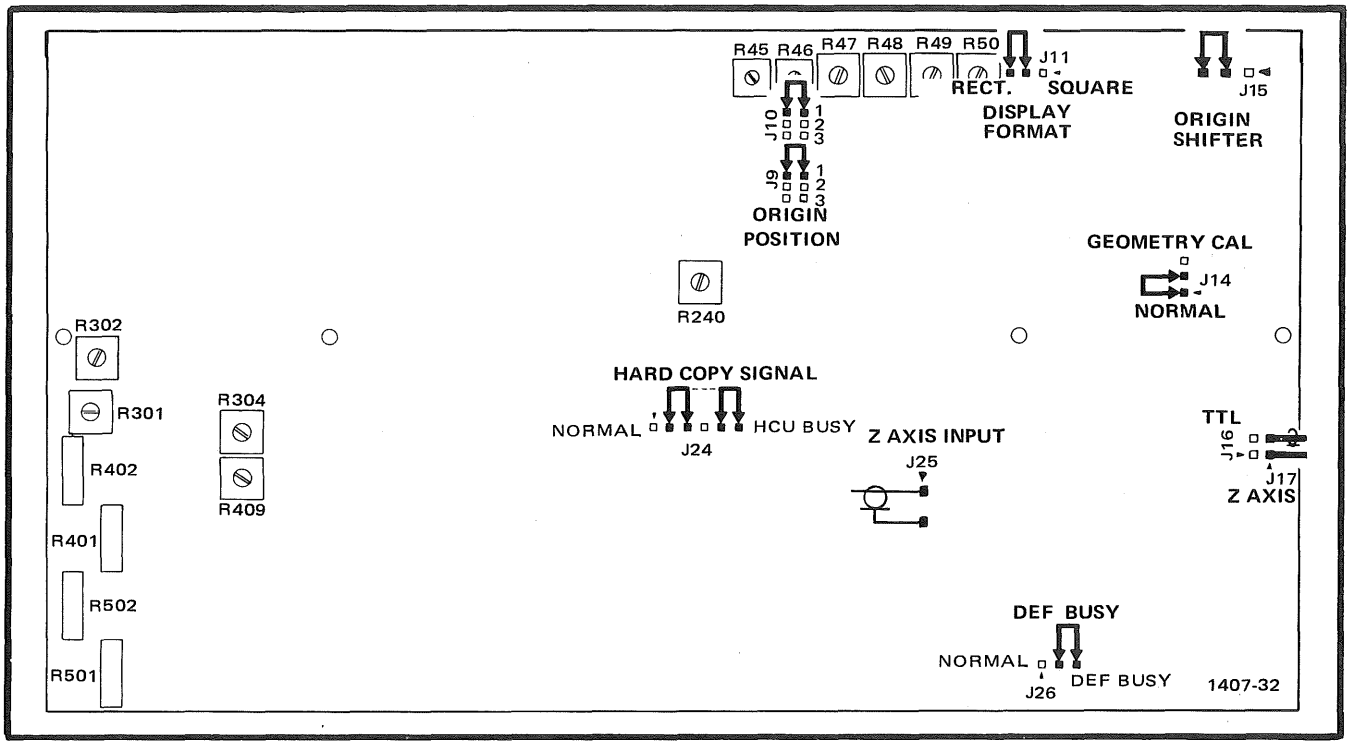


Fig. 3-1. Locations of strap option jumpers on the Deflection Amp board in preparation for calibration of the 613.

POWER SUPPLIES

Equipment Required

1. Precision dc voltmeter and voltage divider
2. Test Oscilloscope with 1X Probe
3. Autotransformer

Control Settings

Test Oscilloscope

Vert Mode	Ch 1
Int Trig	Norm

Time-Base A

Time/Div	5 ms
Trigger Level	0
Trigger Slope	+
Trigger Coupling	AC
Sweep Mode	Auto Trig
Source	Int

Vertical Amplifier

Mode	Ch 1
Volts/Div	.005
Input Selector	AC

Precision DC Voltmeter and Divider

As required for voltage and polarity.

1. Check/Adjust +15 Volt Supply

a. Connect the precision dc voltmeter between TP68 on the Power Supply board and ground. See Fig. 3-2.

b. Check the +15 Volt Supply for a reading of +15 V (±75 mV).

c. Adjust R12, (+15 Volts) for a reading of exactly +15 V on the dc voltmeter. (If necessary to bring one of the other regulated supplies within tolerance, the +15 Volt supply can be adjusted later within the ±75 mV tolerance limit. The +15 Volt Supply is the reference supply for all supply voltages in the 613.)

2. Check Low Voltage Power Supplies

a. Connect the dc voltmeter to each of the test points called out in Table 3-1 and shown in Fig. 3-2, and measure each of the additional regulated and nonregulated supplies to the tolerances listed in Table 3-1. Voltages shown for the unregulated supplies are approximate, and no tolerances are listed.

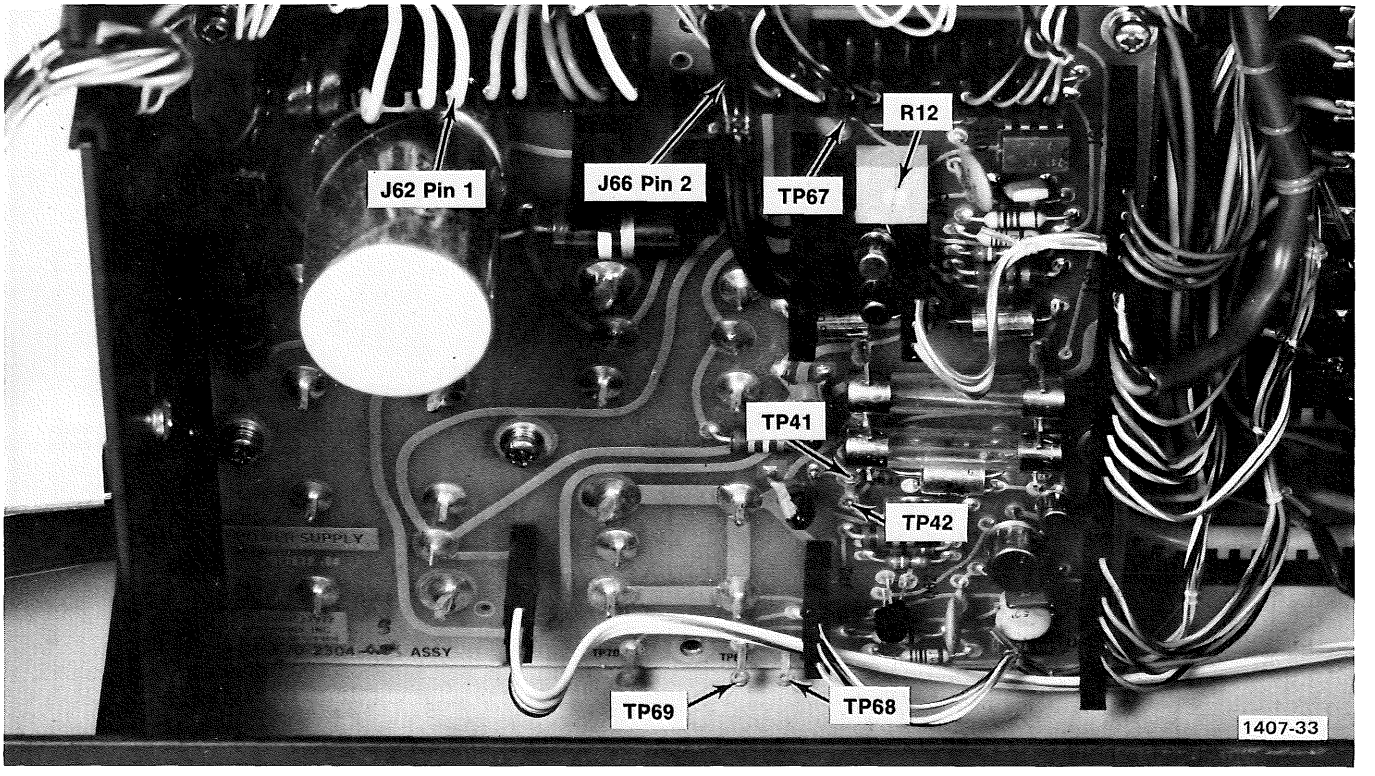


Fig. 3-2. Locations of test points and adjustments on the Power Supply board.

TABLE 3-1

Low Voltage Power Supply Tolerances and Ripple Limits

Supply	Test Point	Accuracy	Ripple (2X Line Frequency)
+15 V	TP68	±0.5% (±75 mV)	10 mV
−15 V	TP69	±1.5% (±225 mV)	10 mV
+5 V	TP67	±5% (±250 mV)	10 mV
+25 V	F31 (3A fuse)		2 V
−25 V	TP42		2 V
+175 V	J66 pin 2		2 V
+350 V	J62 pin 1		8 V
+550 V	J62 pin 4		12 V

b. Connect the 1X probe from the test oscilloscope Channel 1 input to each power supply test point in succession to measure the amount of ripple displayed on each supply. On checks of the regulated supplies (+15 V, −15 V, +5 V), vary the output of the autotransformer between 103 and 126 volts as the checks are being made. In each of these cases, watch the test oscilloscope display during the supply voltage changes to check that the supply stays in regulation.

c. Return to normal line voltage.

3. Check Flood Gun Voltage

a. Connect the leads of the precision dc voltmeter between TP41 (+) and TP42 (−) and measure a voltage of about 26 V (±10%, or 23.4 V to 28.6 V). See Fig. 3-2.

4. Adjust High Voltage

a. Turn off the 613. Using the precision voltage divider with the dc voltmeter, connect the meter to TP51 (accessible through the High Voltage Shield at the left rear of the 613). See Fig. 3-3. Turn the 613 on.

b. Check the dc voltmeter for a reading of −6000 V ±5% (300 V). If the reading is not within these limits, adjust R226 (also accessible through the High Voltage Shield) for a reading of −6000 V. Turn the 613 off. Disconnect the meter.

c. This completes the power supply checks. The 613 can now be disconnected from the autotransformer and connected directly to the power outlet. Turn the 613 on.

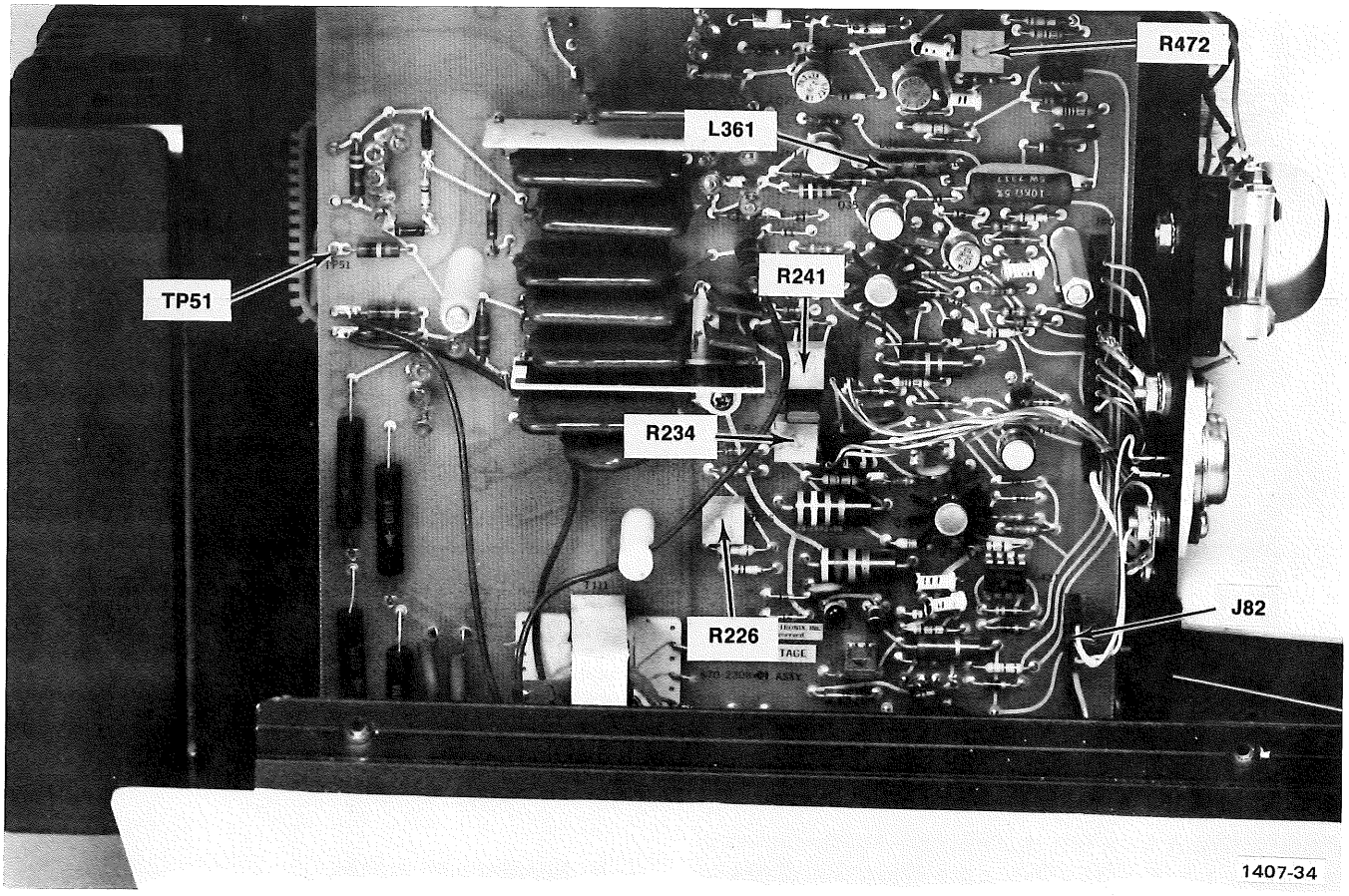


Fig. 3-3. Locations of test points and adjustments on the HV and Z-axis board.

STORAGE

Equipment Required

1. DC Voltmeter

2. Test Oscilloscope and 10X Probe

Control Settings

Test Oscilloscope

Vert Mode	Ch 1
Int Trig	Norm

Time-Base A

Time/Div	5 ms
Trigger Level	—
Trigger Slope	—
Trigger Coupling	AC
Sweep Mode	Auto Trig
Source	Int

Vertical Amplifier

Mode	Ch 1
Volts/Div	50
Input Selector	DC

5. Adjust Collimation Voltage

a. Connect the dc voltmeter to J48 pin 1 on the Storage board (see Fig. 3-4). Adjust R103 to produce a meter reading that agrees with the crt CE voltage on the crt voltage tag attached to the metal shield.

6. Adjust Operating Level

a. Connect the dc voltmeter to the emitter of Q153 (bottom pin) and adjust OPERATING LEVEL R1010 (on the rear panel) for a meter reading that agrees with the crt Storage Level voltage on the crt voltage tag. It may be necessary to adjust Collimation Voltage and Operating Level during calibration, with fine adjustments being made for best display resolution.

NOTE

The Operating Level voltage on the 613 Storage crt is not a permanently-fixed value. As the tube ages, the Operating Level voltage will generally have to be increased in order to provide satisfactory performance.

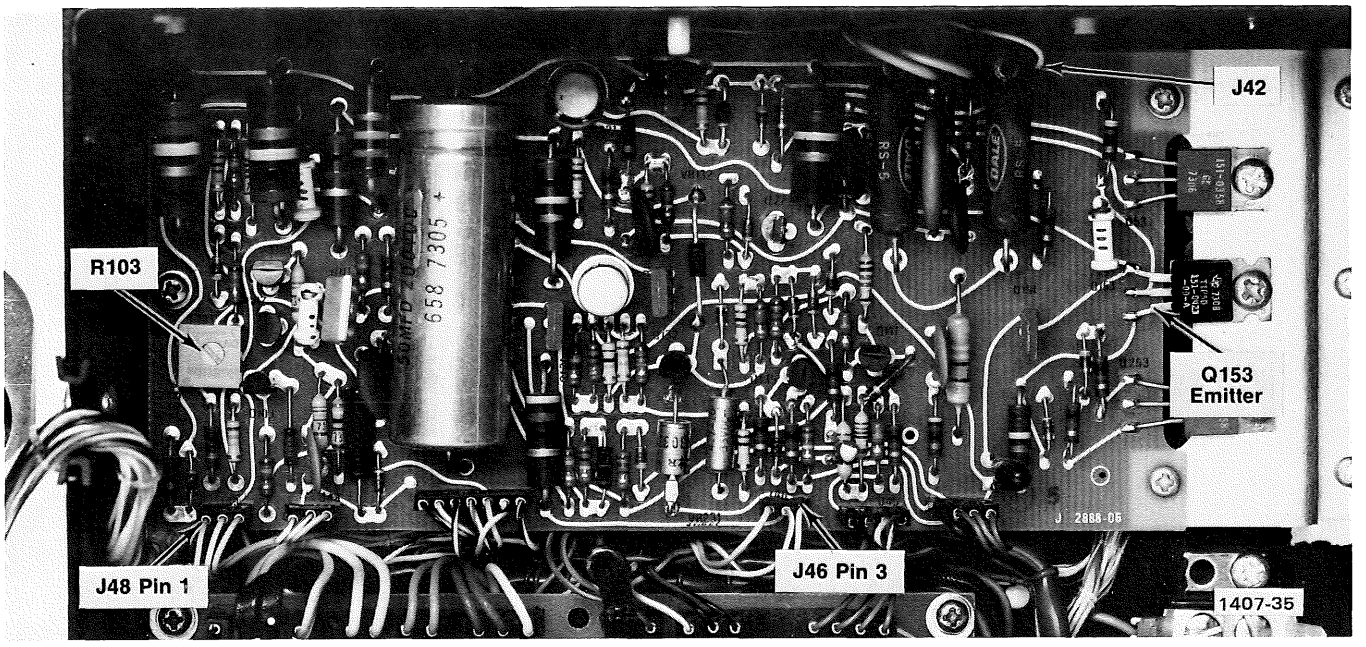


Fig. 3-4. Storage board locations of adjustments and test points.

7. Check Erase Sequence

a. Connect the 10X probe to the − side of C12 on the Storage board (J46 pin 3) and press the ERASE button on the 613. Check for a test oscilloscope display similar to waveform 1 of Fig. 3-5. This is the Flood Gun Cathode waveform.

b. Connect the 10X probe to J42 (emitter of Q53), press the VIEW and the ERASE buttons and check for a test oscilloscope display similar to waveform 2 of Fig. 3-5. This is the Flood Gun Anode waveform.

c. Set the oscilloscope trigger source switch to Ext ÷ 10 and connect a 1X probe from the oscilloscope external trigger input to J46 pin 3.

d. Connect the test probe to J46 pin 1 and set the Time/Div at 0.1 second. Press the ERASE button and check for a test oscilloscope display similar to waveform 3 of Fig. 3-5. This is the Storage Target waveform. Trigger on the negative-going pulse edge.

e. Connect the test probe to J46 pin 2. Press the ERASE button and check for a test oscilloscope display similar to waveform 4 of Fig. 3-5. This is the Collimation waveform.

f. Connect the probe to J22 pin 1 on the Deflection Amplifier board and set the Volts/Div at 2.

g. Press the ERASE button and check for a test oscilloscope waveform similar to waveform 5 of Fig. 3-5. This is the $\overline{\text{BUSY}}$ waveform.

h. Remove both probes.

Z-AXIS

Equipment Required

1. Test Display Generator 067-0561-01 (or a 067-0561-00 that has been modified in accordance with instructions at the beginning of this procedure).

2. Test Oscilloscope with 10X Probe

Control Settings

Test Display Generator

Mode	Cont
	Raster
Density	Horiz.
	Dots
	25
Variable	Cal
Time/Dot	5 μs
DC Offset	Off
Remote Program Test	Non-Store
View	Off
Write Through	Off
Amplitude	1 V
Output Signal Source	Norm

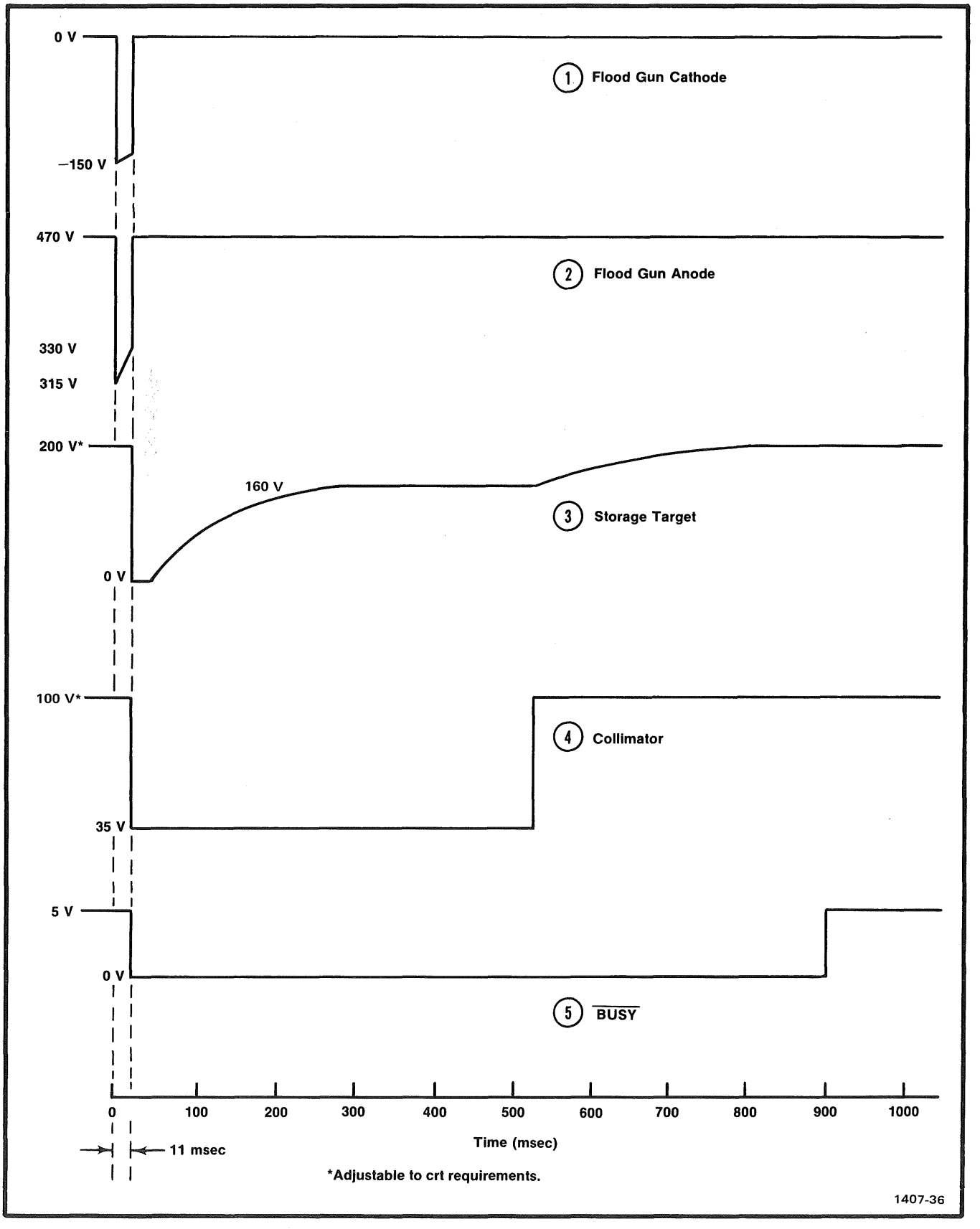


Fig. 3-5. Erase Sequence waveforms.

Test Oscilloscope

Vert Mode	Ch 1
Int Trig	Norm

Time-Base A

Time/Div	5 μs
Trigger Level	0
Trigger Slope	+
Trigger Coupling	AC
Sweep Mode	Auto Trig
Source	Int

Vertical Amplifier

Mode	Ch 1
Volts/Div	1
Input Selector	DC

8. Adjust Writing Intensity Preset

a. Turn INTENSITY control R1028 (on back panel) completely off.

b. Carefully adjust R234, which is on the High Voltage board (Fig. 3-3), for a dot display to determine the correct rotation to turn off the beam. Then set the control at its fully-off position.

c. Remove the connector from J701 and put 50 Ω terminations on the 613 X and Y input connectors.

d. Connect a cable from the Test Display Generator Z Out connector to the 613 Z Input connector.

e. Adjust R234 on the High Voltage board (Fig. 3-3) so that the single dot is barely displayed in the lower left corner; then back off the control to just extinguish the dot. If the dot is not located, turn the control off, set J9 and J10 jumpers to position 2 to put the dot in center screen, and repeat the first portion of this step. Return the jumpers to position 1.

f. Remove the two 50 Ω terminations from the X and Y axis and the coaxial cable from the Z-axis. Restore the connector on J701.

g. Adjust the rear-panel control (R1028) to display the dot pattern.

h. Switch the Test Display Generator Amplitude control to 0.5 V and check that the display turns off.

i. Switch back to 1 V to turn on the display.

9. Check Z-axis Rise- and Fall-Time

a. Control settings on the Test Display Generator remain as they were at the conclusion of Step 8. Set the Test Oscilloscope Volts/Div at 10, and Time/Div at 0.2 μs.

b. Turn the 613 POWER switch off, and remove the High Voltage Shield from the 613. Turn the 613 POWER on, and connect the test oscilloscope 10X Probe to the left end of L361 on the High Voltage and Z-axis board (see Fig. 3-3).

c. Using the test oscilloscope Volts/Div Variable, set the test oscilloscope display for an amplitude of 5 divisions. Measure the Z-axis risetime on the test oscilloscope display. It should be 0.2 μs or less within the 10% to 90% portion of the waveform rise.

d. Switch the Trigger Slope on the test oscilloscope to −. Measure the Z-axis falltime at 0.2 μs or less within the 10% to 90% portions of the waveform fall.

e. Set the Volts/Div Variable to Cal.

DEFLECTION AMPLIFIERS

Equipment Required

1. Test Display Generator
2. 4610 Hard Copy Unit (Optional)
3. Test Oscilloscope with 10X Probe

Control Settings

Test Display Generator

Mode	Cont Raster
Density	Horiz Lines 25
Time/Line	2 ms
Remote Program Test	Non-Store
View	Off
Write Through	Off
Output Signal Source	Norm
DC Offset	Off

Test Oscilloscope

Vert Mode	Ch 1
Int Trig	Norm

Time-Base A

Time/Div	1 ms
Trigger Level	0
Trigger Slope	+
Trigger Coupling	DC
Sweep Mode	Auto Trig
Source	Int

Vertical Amplifier

Mode	Ch 1
Volts/Div	5 mV (1X Probe)
Input Selector	AC

Standard Amplitude Calibrator

Amplitude	1 V
Mode	Square wave
Output switch	Up

10. Adjust Common Mode

a. Turn the 613 INTENSITY control fully off.

b. To ensure that identical signals are applied to the + and − inputs of the X and Y Deflection Amplifiers, tie pins 1 and 2 of J12 (on the Deflection Amplifier board) together, and tie pins 3 and 4 together (see Fig. 3-6).

c. Connect the 1X probe to J14 pin 3 on the Deflection Amplifier board. Ground the probe ground clip.

d. Adjust R48 (Short-axis Common Mode Null) for a straight-line display on the test oscilloscope.

e. Set the Test Display Generator Density to Vert.

f. Connect the probe to J14 pin 1.

g. Adjust R49 (Long-axis Common Mode Null) for a straight-line trace display on the test oscilloscope.

h. Disconnect the jumpers tying pins 1 and 2, 3 and 4 of J12 together.

11. Adjust Trace Alignment and Geometry

a. Set the Test Display Generator Mode Switch to Continuous, Raster; Density to Horiz, Lines; Time/Line to 2 ms; Remote Program Test to Non-Store. Increase the 613 INTENSITY for a visible display.

b. Adjust R402 (Long-axis Geom) until the lines in the display appear to be straight. If a new crt has been installed, the deflection yoke will need to be adjusted. To adjust the yoke, loosen the two set screws at the back of the crt shield (see Fig. 3-7) and adjust the handle at the top of the shield so that the center vertical line of the display aligns with the center vertical line of the test graticule.

c. Set the Test Display Generator Density to Vert, and make a similar geometry adjustment with R401 (Short-axis Geom).

d. Set the Test Display Generator Density to Horiz.

e. Move the jumper on J14 on the Deflection Amplifier board (Fig. 3-6) to its alternate position (pins 2 and 3). this should cause a single diagonal line to appear on the display, starting at the lower left corner of the screen and extending to the upper right corner. Adjust R401 and R402 until the line appears straight.

f. Return the J14 jumper to its original position (pins 1 and 2).

12. Adjust Main Amplifier and Preamplifier Centering and Size

NOTE

Users of Test Display Generator 067-0561-00 should use Step 12 (alternative).

a. Turn the 613 INTENSITY control off.

b. Connect the J15 jumper on the Deflection Amplifier board (see Fig. 3-6) to the CAL position (pins 2 and 3) to disable the Origin Shifter.

c. Connect the Test Display Generator cables to J701 and J705 on the 613. Set the Density to Horiz and the Output Signal Source to Hard Copy.

d. Adjust the H C INTENSITY control to display the horizontal (613-1: vertical) lines.

e. Adjust R502 (Long-axis Centering) and R302 (Long-axis Size) to center the lines on the graticule and set the line length to 20 cm (Fig. 3-6).

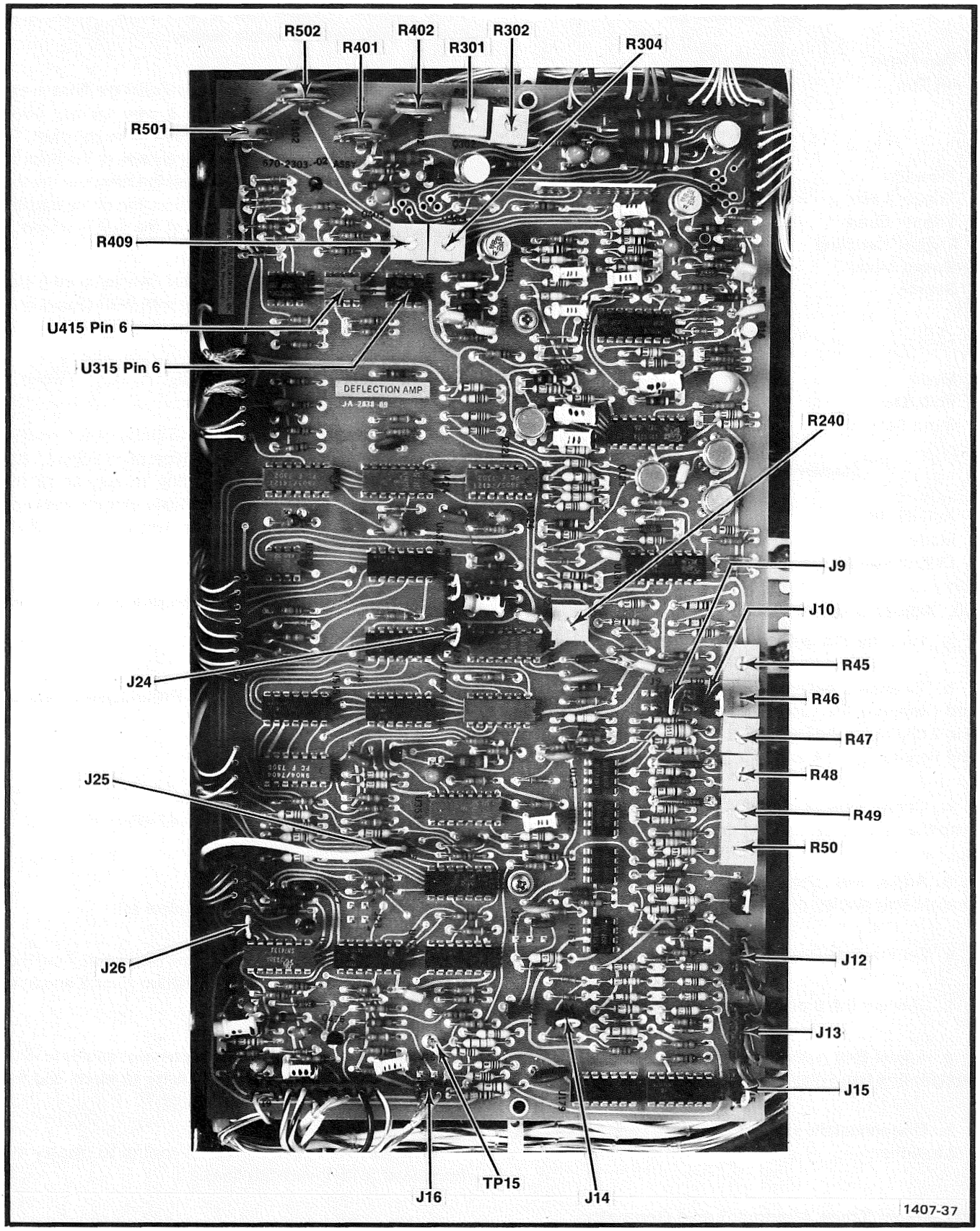


Fig. 3-6. Deflection Amplifier board controls and test points locations.

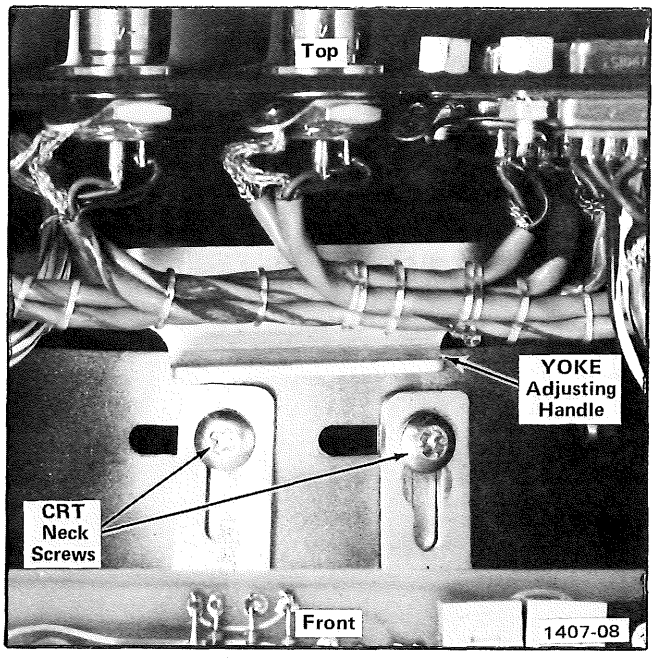


Fig. 3-7. View of the rear portion of the crt shield showing yoke adjustment.

f. Switch the Test Display Generator Density to Vert.

g. Adjust R501 (Short-axis Centering) and R301 (Short-axis Size) to center the lines on the graticule and set the line length to 15 cm.

h. Turn the 613 INTENSITY control off and disconnect the cables from J701 and J705.

i. Connect a cable from the Standard Amplitude Calibrator Output to the 613 X input.

j. Connect cables from the Test Display Generator Y and Z out to the 613 Y and Z inputs. Set the Output Signal Source to Norm and the Density to Vert.

k. Set the Standard Amplitude Calibrator for a 1 V square-wave and adjust the 613 INTENSITY control to display two lines.

l. Adjust R46 (Long-axis Input Position) to place the right (613-1: bottom) line 10 cm from the center (Fig. 3-6).

m. Adjust R50 (Long-axis Input Size) to place the left (613-1: top) line 10 cm from the center.

n. Turn off the 613 INTENSITY control, interchange the X and Y cables on the rear of the 613, and adjust the 613 INTENSITY control to display two lines.

o. Adjust R45 (Short-axis Input Position) to place the bottom (613-1: left) line 7.5 cm from the center (Fig. 3-6).

p. Adjust R47 (Short-axis Input Size) to place the top (613-1: right) line 7.5 cm from the center.

q. Turn off the 613 INTENSITY control and remove the 613 X, Y and Z input cables.

12. (Alternative). Adjust Main Amplifier and Preamplifier Centering and Size

NOTE

This step is to be used only if a 067-0561-00 Test Display Generator is being used.

a. Turn off the 613 INTENSITY and the HC INTENSITY.

b. Disconnect the Test Display Generator cable from J701 and erase the display.

c. Connect J18 pin 6 to ground (see Fig. 3-6). Remove P12 and P13 on the Deflection Amplifier board and connect P12 onto J13. Set J15 to pins 2 and 3 (Cal position).

d. Set the Standard Amplitude Calibrator for a 5 V square-wave and connect the signal to the 613 X input BNC connector.

e. Remove the plug from J25 on the Deflection Amplifier board and reconnect it in the reverse position.

f. Turn up the HC INTENSITY control until a dot just appears in the center of the display.

g. Adjust R502 (Long-axis Main Amplifier Centering) to place the dot under the center horizontal graticule line (Fig. 3-6).

h. Adjust R302 (Long-axis Main Amplifier Size) to place the second dot 10.5 cm to the right of (613-1: below) the center dot, then switch to (−) dc and check for a total dot shift of 21 cm. Switch back to the square-wave signal.

i. Remove the coaxial cable for the X input and connect it to the Y input.

j. Adjust R501 (Short-axis Main Amplifier Centering) to place the dot under the center vertical graticule line.

k. Adjust R301 (Short-axis Main Amplifier Size) to place the second dot 7.875 cm above (613-1: right of) the center dot; then switch to (−) dc and check for a total dot shift of 15.75 cm. Switch back to the square-wave.

l. Reconnect P25 in its normal position.

m. Disconnect the ground on J18 pin 6 and reconnect P12 to J12 and P13 to J13.

n. Set J9 and J10 jumpers to position 1.

o. Set the Standard Amplitude Calibrator to 1 V square-wave and connect the output to the X input BNC connector on the 613 rear panel.

p. Set the Test Display Generator controls. Mode: Cont, Raster; Density: Vert, Lines, 25; Remote Program Test: Non-Store; Time/Line: 2 ms; DC Offset: Off; Output Signal Source: Int.

q. Connect the Y and Z output signals from the Test Display Generator to the Y and Z input BNC connectors on the 613 rear panel.

r. Turn up the 613 INTENSITY control to display two lines.

s. Adjust R46 (Long-axis Input Position) to place the right (613-1: bottom) line 10 cm from the center (Fig. 3-6).

t. Adjust R50 (Long-axis Input Size) to place the left (613-1: top) line 10 cm from the center.

u. Turn down the 613 INTENSITY control, interchange the X and Y input coaxial cables, and turn up the 613 INTENSITY control to display the two lines.

v. Adjust R45 (Short-axis Input Position) to place the bottom (613-1: left) line 7.5 cm from the center.

w. Adjust R47 (Short-axis Input Size) to place the top (613-1: right) line 7.5 cm from the center.

x. Turn down the INTENSITY control and disconnect the 613 input cables.

DISPLAY ALIGNMENT

Equipment Required

1. Test Display Generator

2. Test Oscilloscope with 10X Probe

Control Settings

Test Display Generator

Mode	Cont Raster
Density	Vert Lines 25
Time/Line	2 ms
Remote Program Test	Non-Store
Amplitude	1 V
DC Offset	Off

Test Oscilloscope

Vert Mode	Ch 1
Int Trig	Norm

Time-Base A

Time/Div	1 ms
Trigger Level	0
Trigger Slope	+
Trigger Coupling	DC
Sweep Mode	Auto Trig
Source	Int

Vertical Amplifier

Mode	Ch 1
Volts/Div	0.1
Input Selector	DC

13. Recheck Geometry and Check Display Linearity

a. Connect the Test Display Generator output cable to the J701 connector of the 613.

b. Recheck the geometry as described in Step 11.

c. Set the Test Display Generator Density control to Vert and the DC Offset switch to on.

d. Adjust the X and Y DC Offset controls to place the display on the crt with the extreme-left, vertical display line at the left graticule edge (10 cm left of center. 613-1: 7.5 cm left of center).

e. Adjust the Density Variable for one display line at each graticule line, with lines at the first and last graticule lines accurately positioned.

f. Select alternate lines and find a pair that has the greatest separation and a pair that has the least separation. Check that the difference in spacing between the two pairs is not greater than 3 mm (15% of 2 cm). The spacing of the line pairs should be checked at both ends of the lines.

g. Set the Density to Horiz and place the bottom line 7.5 cm (613-1: 10 cm) below graticule center.

h. Adjust the Density Variable for one line per division with the top and bottom lines accurately positioned.

i. Repeat Step f.

14. Check Orthogonality

a. Set the Test Display Generator Density to Horiz (613-1: Vert).

b. Establish a reference display line that is parallel to and superimposed under the center horizontal graticule axis by adjusting the DC Offset. If this cannot be accomplished, then do a similar procedure using a vertical input signal, or physically rotate the graticule.

c. Switch the display lines to vertical (assuming the first case) and adjust the DC Offset to place the bottom end of the center vertical display line under the intersection of the bottom graticule margin line and the center vertical graticule line.

d. Measure the distance of the display line away from the corresponding point at the top end of the graticule line. The maximum 613 tolerance of 2.6 mm (613-1: 3.5 mm) is indicated on the top of the graticule. If the alternative procedure in part b is used, then the two tolerances are interchanged. The axes are 90° ±1° if within the given tolerances.

15. Adjust $\overline{\text{BUSY}}$ Null

a. Set the Test Display Generator Density to Vert.

b. Connect the 10X probe to pin 6 of U315 on the Deflection Amplifier board, and adjust R304 (Long-axis BUSY Null) for a straight-line trace display on the test oscilloscope. (Faint spikes may appear on the trace, but these can be disregarded.)

c. Set Test Display Generator Density to Horiz.

d. Move the 10X probe to pin 6, U415, and adjust R409 (Short-axis BUSY Null) for a straight-line trace display on the test oscilloscope.

CATHODE RAY TUBE

Equipment Required

1. Test Display Generator
2. DC Voltmeter
3. 4610 Hard Copy Unit (Optional)

Control Settings

Test Display Generator

Mode	Cont
	Raster
Density	Horiz
	Dots
	25
Variable	Cal
Time/Dot	5 μs
DC Offset	On
Remote Program Test	Non-Store
View	On
Write Through	Off
Amplitude	1 V

16. Adjust CRT Grid Bias

a. Use the DC Offset X and Y controls on the Test Display Generator to center the dot raster display on the 613 display screen.

b. Carefully, to prevent a crt burn, rotate R234 (on the High Voltage board, Fig. 3-3) to determine the rotation direction that turns off the display. Set the control at its extreme off position.

c. Turn the rear-panel 613 INTENSITY control to maximum.

d. Set the Test Display Generator Mode switch to Ready.

e. Adjust R234 so that the dot just appears and then back off on R234 to the point where the dot just disappears.

f. Switch the Test Display Generator Mode switch to Cont.

g. Check that the INTENSITY control completely extinguishes the display.

17. Preset Hard Copy Intensity (without Hard Copy Unit)

a. Preset R240 (Cursor Intensity) on the Deflection Amplifier board (Fig. 3-6) to mid-range. Set R1030 (H C Int on the 613 rear panel) to mid-range.

b. Set Test Display Generator Remote Program Test to Store, Write Through to On; Mode to Ready.

c. Check that the 613 display is in a ready-to-write state, with the cursor spot displayed at the lower left corner of the screen. If the cursor is not displayed, adjust R241 (on the HV and Z-axis board, Fig. 3-3) until it becomes visible.

d. Turn the Test Display Generator DC Offset on. With the X and Y DC Offset controls, position the cursor into the viewing area.

e. Use the X and Y DC Offset controls to position the cursor around to different positions on the 613 display screen. If the cursor stores at any position on the screen, adjust R240 (Cursor Intensity, Fig. 3-6) until the cursor does not store at any point on the display screen.

f. Turn the Test Display Generator Write Through off.

18. Adjust Focus

a. Set Test Display Generator Mode to Cont, Raster; Density to Vert, Dots, 125:100, Variable counterclockwise; Time/Dot, 5 μs; Amplitude, 1 V; DC Offset, On.

b. Use the X and Y DC Offset controls on the Test Display Generator to center the raster display on the 613.

c. Preset R472 (Dynamic Focus) on the High Voltage and Z-axis board (Fig. 3-3) to mid-range.

d. Adjust R171 (rear panel Focus) so that the dots displayed at screen center are at best focus (dot edges sharp, dots minimum size), then adjust slightly beyond optimum focus (dots increase slightly in size, but retain sharp outlines).

e. Next, adjust R472 to make the displayed dots in all parts of the 613 display screen as nearly alike as possible. Use of a 9X or 12X magnifying glass (jeweler's loupe) can be helpful in making precise adjustments of dot size and focus.

f. Switch the Test Display Generator Mode to Single, Density to Dots, 200:266, Variable to Calibrated, Remote Program Test to Store. For a 067-0561-00 Test Display Generator, connect a test oscilloscope to the X output BNC connector, set the Dot Density control at 300:400 and adjust the variable control for a sawtooth duration of 9 ms when in the XY position.

g. Check the stored raster display on the 613 to see that dots are stored on all parts of the screen, that focus is good throughout, and that there is minimal dot dropout. (See Fig. 3-8.) Erase the display and store it again (using single sweep). Repeat two or three times as a check.

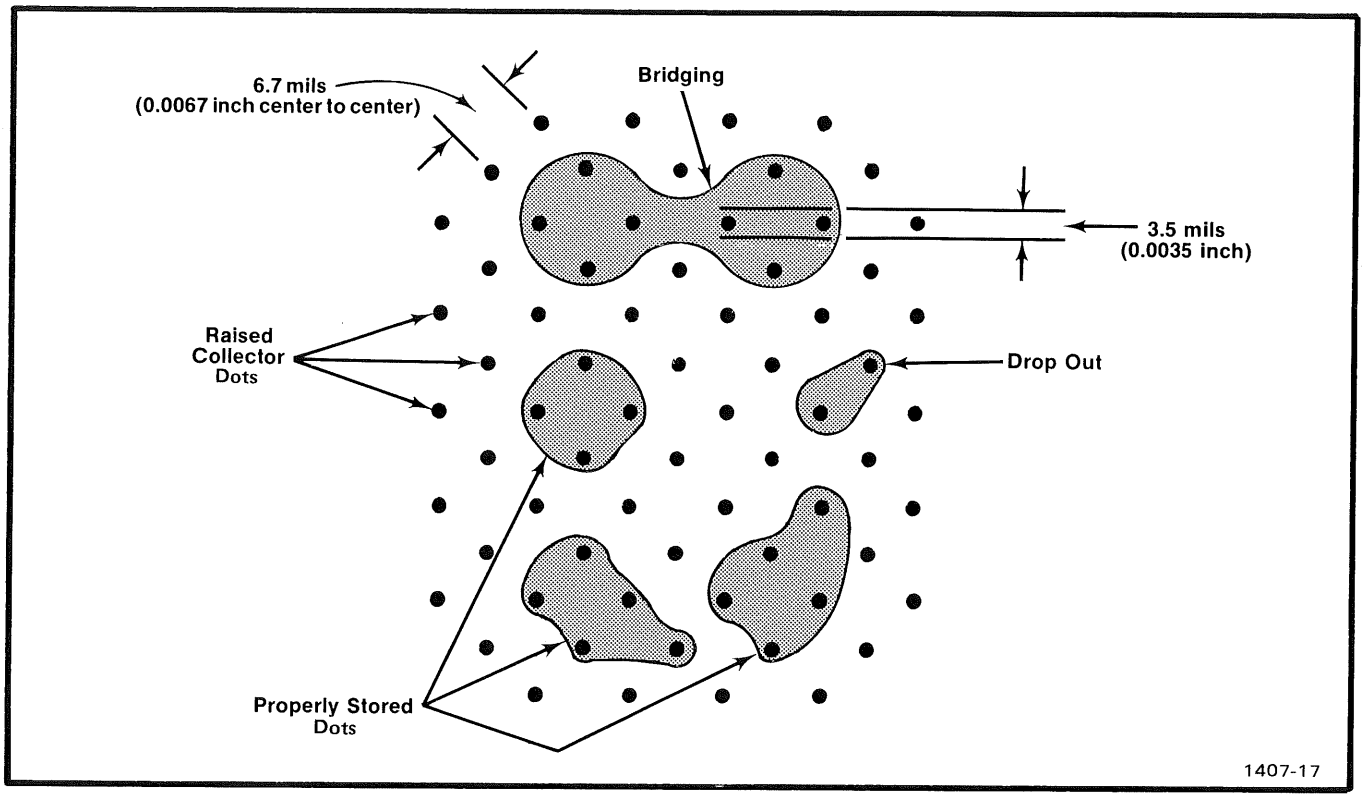


Fig. 3-8. Magnified view of dot display showing dot storage. A properly stored dot must enclose a minimum of three raised collector dots that are not in a common row.

SETTLING TIME

Equipment Required

1. PG501 Pulse Generator
2. Test Oscilloscope with 10X Probe
3. TG501 Time-Mark Generator
4. 5X and 10X Attenuators
5. Sweep Attenuator
6. 50 Ω Termination
7. Coaxial Cables

Control Settings

Test Oscilloscope

Vert Mode	Ch 1
Sweep Mode	Auto Trig
Time/Div	20 μs
Trigger Level	fully clockwise
Trigger Slope	+
Trigger Coupling	AC
Trigger Source	Ext
Source	Int

Vertical Amplifier

Mode	Ch 1
Volts/Div	.05
Input Coupling	DC

TG501 Time-Mark Generator

Marker Selector	5 μs

PG501 Pulse Generator

Period	External Trig
Variable	X1
Pulse Duration	10 μs
Variable	mid-range
Output Amplitude (+)	mid-range

19. Check Settling Time

a. Turn the 613 INTENSITY control fully off.

b. Connect a coaxial cable from the TG501 Marker Out connector to the 613 rear-panel Z Input BNC connector. Connect another coaxial cable from the TG501 Trigger Out to the test oscilloscope Trigger Input.

c. Connect the Sweep A banana plug of the Sweep Attenuator to the test oscilloscope Sweep A connector, using adapters as necessary. Connect the Sweep Attenuator Gnd lead to test oscilloscope chassis ground. Connect a coaxial cable from the Sweep Attenuator Output connector to the 613 Y Input BNC connector.

d. Connect the signal from the PG501 (+) Output through a 10X attenuator, a coaxial cable and a 50 Ω termination to the 613 X Input BNC connector. Connect all items in the given order.

e. Connect a coaxial cable from the test oscilloscope + A Gate to the PG501 Trig In.

f. Set the Sweep Attenuator to mid-range.

g. Turn up the 613 INTENSITY to normal viewing range. Adjust the test oscilloscope Triggering Level until a dot display appears on the 613. Adjust the PG501 Out Amplitude until the displayed pulse amplitude is 15 cm. Adjust the Sweep Attenuator to obtain a long-axis sweep length comparable to the illustration in Fig. 3-9.

h. Use the PG501 Pulse Duration Variable to adjust the display until a dot just begins to break away from the top of the waveform. Settling Time is measured by counting the dots displayed between this break-away point and the point where the dots are positioned within one dot's width of the waveform baseline. Each dot represents 5 μs of settling time. Refer to the display of Fig. 3-9.

Check the settling time for pulse amplitudes of 15, 8, 2 and 1 cm. The settling time is equal to 14 μs + 6 μs/cm up to 2 cm + 3 μs/cm for the remaining distance. The maximum settling times for 15, 8, 2 and 1 cm are 65, 44, 26 and 20 μs respectively. Use 1 μs markers to aid in measuring the time near the pulse baseline. The pulse amplitudes

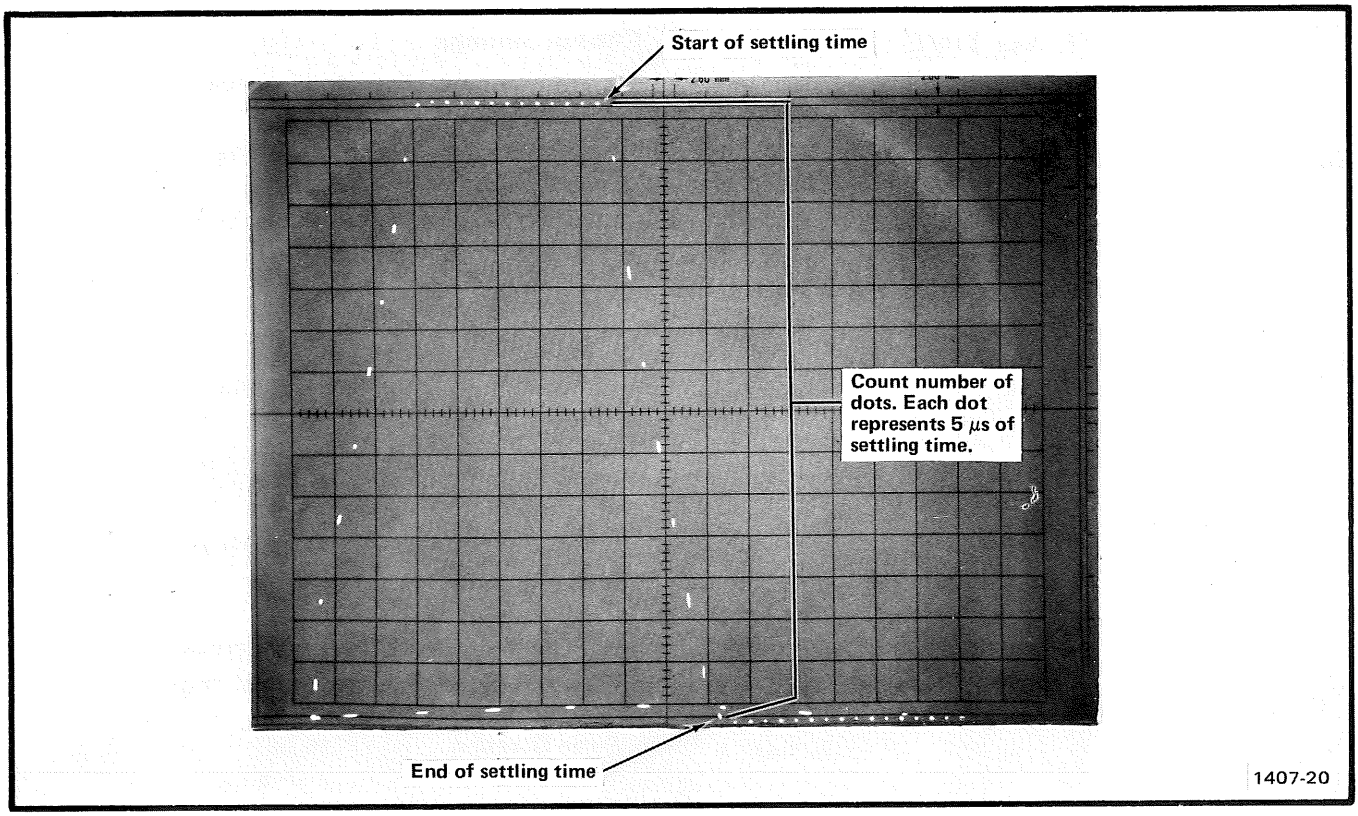


Fig. 3-9. Measurement of settling time on the short-axis.

are obtained by setting the Output Amplitude and inserting a 5X or 10X attenuator into the pulse signal line as necessary.

i. Turn down the 613 INTENSITY, interchange the cable connections to the 613 X and Y rear panel inputs, and turn up the INTENSITY again to obtain a display in the Long-axis direction; see Fig. 3-10. Adjust the appropriate sweep length and waveform amplitude with the Sweep Attenuator and PG501 Output Amplitude. Use the PG501 Pulse Duration Variable to position the break-away dot, and count the dots again as in part h.

Check the settling time for pulse amplitudes of 20, 10, 2 and 1 cm. The maximum respective times are 80, 50, 26 and 20 μs respectively.

j. Disconnect the test oscilloscope, the PG501 and the TG501 from the 613.

20. Check View Timer

Press the 613 VIEW button and check for a stored background display. Watch the display to observe that the 613 drops into Hold Mode within 90 seconds ±30 seconds.

HARD COPY AMPLIFIER

Equipment Required

1. Test Oscilloscope with two 10X Probes
2. 4610 Hard Copy Unit
3. Test Display Generator

Control Settings

Test Oscilloscope

Vert Mode	Ch 1
Sweep Mode	Auto Trig
Time/Div	1 μs
Trigger Level	0
Trigger Slope	+
Trigger Coupling	AC
Trigger Source	Ext

Vertical Amplifier

Mode	Chop
Volts/Div (Ch 1 & 2)	1
Input Coupling	DC

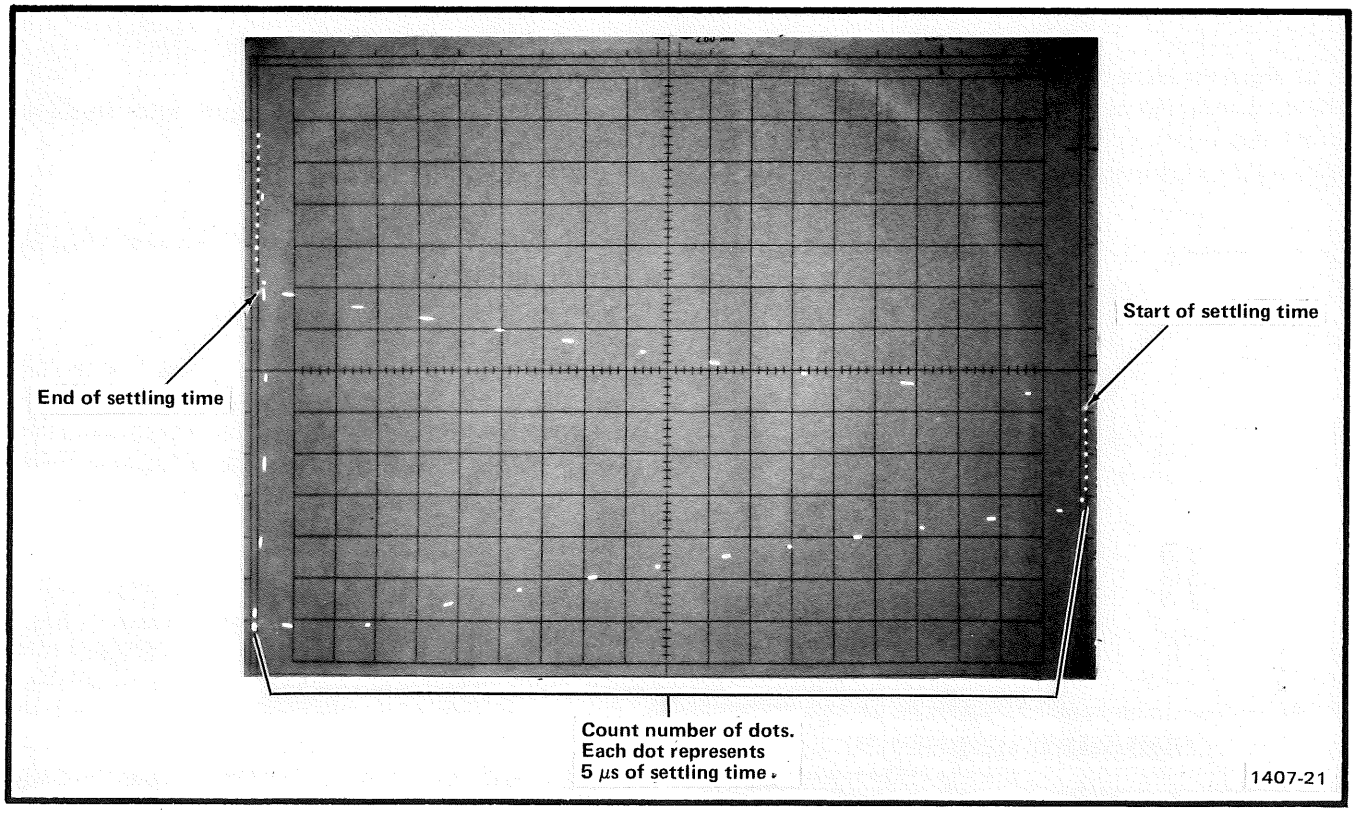


Fig. 3-10. Measurement of settling time on the long-axis.

Test Display Generator

Mode	Ready
	Raster
Density	Horiz
	Lines
	25
Variable	Cal
Time/Dot	5 μs
DC Offset	Off
Remote Program	Store
View	Off
Write Through	Off
Amplitude	1 V

21. Adjust Hard Copy Intensity

a. Install the emi shield onto the crt. The side having the silver painted corners is the front side. Do not touch the back (coated) side.

b. Connect the Test Display Generator to J701 on the 613 and connect the 4610 cable to J705. Remove fuse F28 from the 4610 Timing board (see Fig. 3-11).

c. Set the rear panel H C INTENSITY control R1030 at mid-range.

d. Push the Hard Copy button on the Hard Copy Unit. The crt is scanned from bottom to top for the 613 (613-1: from left to right). Adjust R241 on the High Voltage board (Fig. 3-3) to get sweep storage, then back off so that only a very small amount of storage remains (coarse adjustment). Complete the adjustment by adjusting the H C INTENSITY control R1030 so that the beam intensity is just below the storage level (no storage remains). Push the 613 ERASE button and the Hard Copy button as necessary to complete the adjustments.

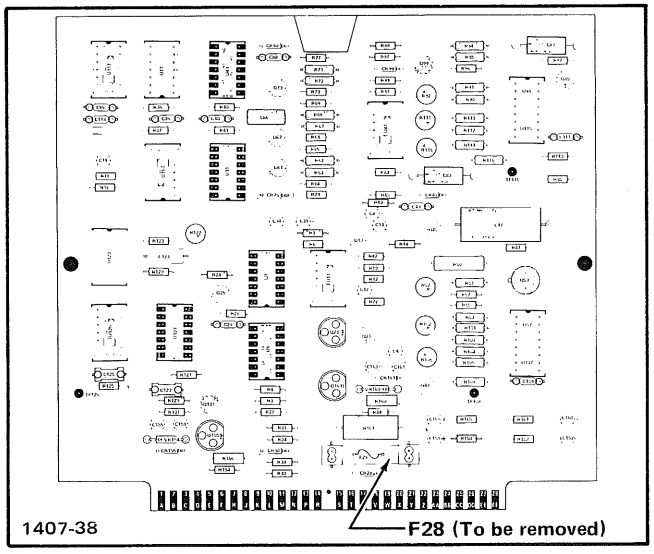


Fig. 3-11. The 4610 Hard Copy Unit Timing board fuse F28 location.

22. Adjust Cursor Intensity

a. Turn off the rear panel INTENSITY control.

b. Turn on the cursor by grounding J21 pin 5 on the Deflection Amplifier board (see Fig. 3-6).

c. Switch on the Test Display Generator DC Offset and position the cursor on the crt.

d. Adjust R240 so that the cursor does not store on the crt and yet has sufficient brightness. Check all portions of the quality area by adjusting the DC Offset.

e. Remove the ground clip from J21 pin 5.

23. Adjust Hard Copy Threshold and Dynamic Threshold

NOTE

This step is to be done only if the 613 is operated with a Hard Copy Unit.

a. Connect a 10X probe from Channel 1 of the test oscilloscope to TP51 on the 613 Hard Copy board and another 10X probe from the test oscilloscope Channel 2 to TP52 on the Hard Copy board (see Fig. 3-12). Ground the probe ground clips to the chassis ground.

b. Connect a 1X probe from the test oscilloscope Ext Trig Input to J18 pin 4 on the Deflection Amplifier board (see Fig. 3-6). This is the Hard Copy Unit $\overline{\text{INTERROGATE}}$ signal input. Connect the probe ground clip to ground.

c. Set the test oscilloscope Vert Mode switch to Chop, the Volts/Div to 1 V (Ch 1 and 2), and each Time/Div to 1 μs.

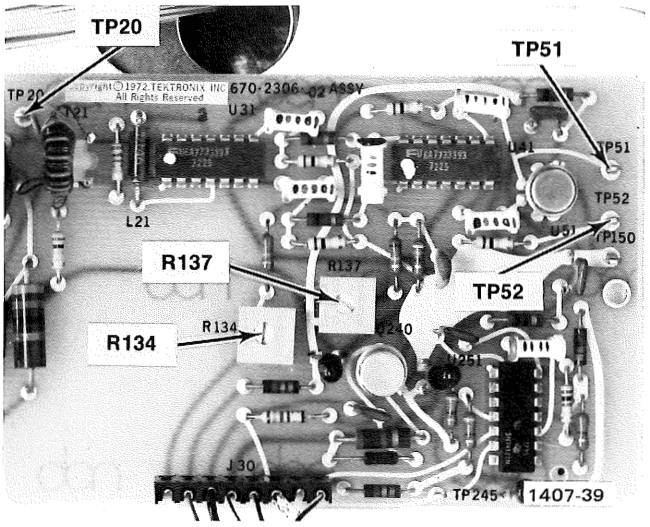


Fig. 3-12. Test points and adjustment locations on the 613 Hard Copy Amplifier boards.

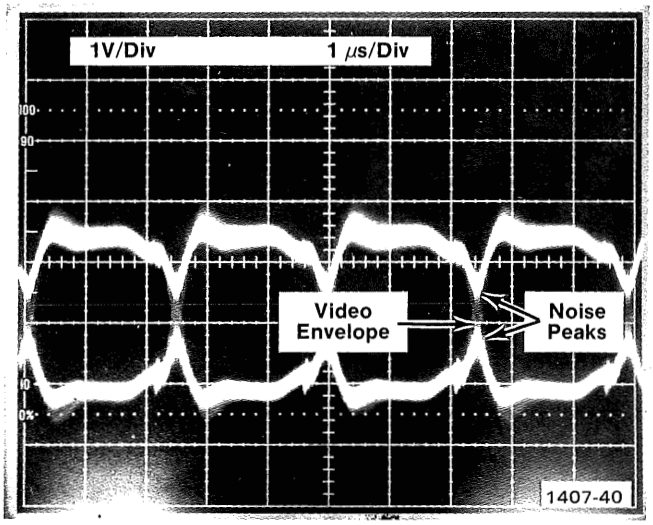


Fig. 3-13. Test oscilloscope waveforms produced after Hard Copy Threshold R137 adjustment.

d. Set both test oscilloscope Input switches to Gnd position and superimpose the two traces at a selected horizontal graticule line on the test oscilloscope display near the bottom of the screen, then switch the Input switches to DC. Set the trigger source switch to Ext.

e. Press the 613 ERASE button so that the crt of the 613 is ready to write, with no information stored, and set the INTENSITY at mid-range. Shift the Test Display Generator Mode switch to Single to store a line display.

f. Preset the Dynamic Threshold control R134 on the Hard Copy board at mid-range.

g. Press the 4610 Copy button and adjust Hard Copy Threshold control R137 to obtain a display similar to Fig. 3-13. The video information at the points of the two waveforms must overlap to generate a TARSIG signal to obtain a hard copy; but too much overlap will include noise, which darkens the copy.

h. Connect the external trigger probe to the fast ramp signal at J13 pin 4 (613-1: J13 pin 3) on the Deflection Amplifier board.

i. Set the test oscilloscope Time/Div at 1 ms and trigger the display. Raise the upper waveform so that there is no overlap between the two traces.

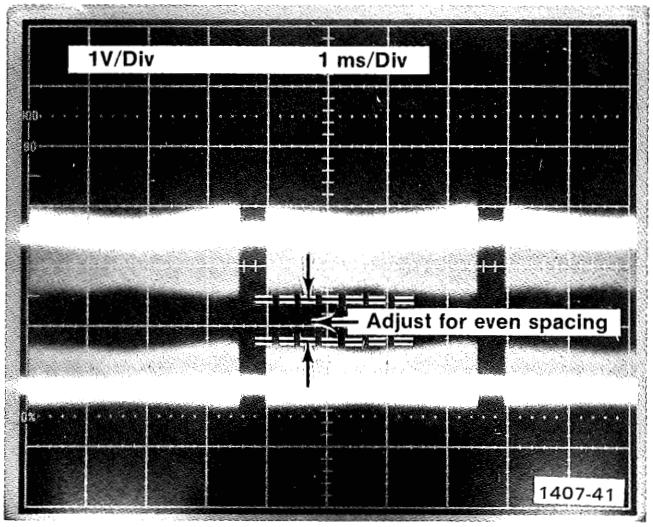


Fig. 3-14. Test oscilloscope waveforms showing the area of adjustment that is controlled by Dynamic Focus control R134. Adjust for even spacing between the waveforms.

j. Adjust the Dynamic Focus control R137 for uniform spacing between the waveforms (see Fig. 3-14). This affects the corner focus.

k. The adjustments interact. Reconnect the trigger probe to J18 pin 4 and check the first waveform.

24. Check Origin Shifter Operation

a. Connect a test oscilloscope with a 10X probe to the unmarked test point (TP15 on the drawing) that is next to J16 near the right edge of the Deflection Amplifier board (see Fig. 3-6).

If the origin shifter circuit is on a separate board, the test probe is connected to TP350 (see Fig. 3-15).

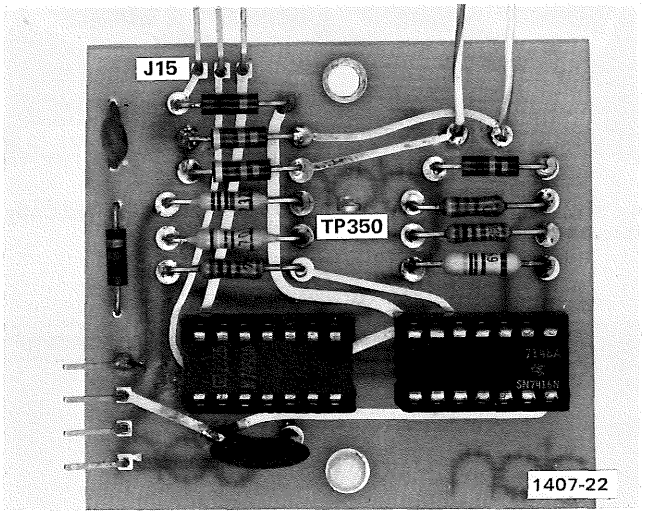


Fig. 3-15. The Origin Shifter circuit (Deflection Amplifier board).

b. Set the test oscilloscope Volts/Div to 0.2 V switch to dc coupling and set the Sweep Mode to Auto Trig.

c. Connect the J15 jumper onto pins 1 and 2 (normal position).

d. Place the trace at the top line of the graticule.

e. Push the 613 ERASE button and observe a decrement of about 0.2 V each time the ERASE button is pushed. There are eight voltage levels in the complete cycle. The maximum voltage is about 1.6 V.

f. Remove the probe and signal connections from the rear panel.

613-1 SQUARE FORMAT

Equipment Required

1. Test Display Generator
2. Standard Amplitude Calibrator

Control Settings

Test Display Generator

Mode	Cont Raster
Density	Vert Lines 25
Variable	Cal
DC Offset	Off
Remote Program Test	Non-Store

Standard Amplitude Calibrator

Amplitude	1 V
Mode	+ DC

25. Square Format (613-1 only)

a. Turn off the 613 INTENSITY control.

b. Put J9 and J10 jumpers in position 1.

c. Connect a 1 V square-wave signal from the Standard Amplitude Calibrator to the 613 X input.

d. Connect the Test Display Generator Y and Z outputs to the 613 Y and Z inputs.

e. Adjust R50 (Long-axis Input Size) on the Deflection Amplifier board to place the upper line 15 cm above the lower line.

f. Turn down the 613 INTENSITY control and remove the input cables.

26. Completion

a. Return all jumpers on the Deflection Amplifier board to their normal operating positions (see Fig. 1-4).

b. Connect the panel light and replace the crt front and dust cover.

FIELD ADJUSTMENT PROCEDURE

The procedure that follows is NOT designed to fully calibrate the 613 to published performance specifications. It is, however, intended as a means of making the instrument perform satisfactorily after repairs, or after performance may have deteriorated because of long operation. No special equipment is required for this procedure other than an accurate dc voltmeter and a source of 10 volt sinewaves or sawtooth signals and 10 volt square-waves at frequencies between 60 Hz and about 10 kHz. If a Hard Copy Unit is regularly used with the 613, it should also be used in the adjustment procedure.

PRELIMINARY PROCEDURE

1. Remove the top dust cover from the 613 by removing the three screws from each side along the feature strip.

2. Remove the green outer light filter from the front of the instrument by removing the four Philips-head screws holding it to the instrument frame. Use caution in removing the filter, to avoid damaging the delicate pins of the Light Emitting Diode that serves as a pilot light at the lower right hand corner. Disconnect the pilot light connector.

3. If the instrument is equipped with an emi shield under the green light filter, remove the shield. A test graticule can be installed if available, or a ruler with centimeter scale may be used for display measurements.

4. Inspect the Deflection Amplifier board to check that the input connectors are correctly installed for the 613 (horizontal format), or the 613-1 (vertical format). Table 3-2 shows the connections.

5. Check that the strap option jumpers are connected as shown in Fig. 3-1. Check that the 613 Low Voltage Power Supply jumpers are connected for correct line voltage (refer to Fig. 1-2).

ADJUSTMENT PROCEDURE

1. Power Supply Checks and Adjustments

a. Disconnect the plug from J82 pins 1 and 2 (+25 V source on the HV and Z-axis board). See Fig. 3-3 for component locations.

TABLE 3-2

Input Connections for 613 and 613-1

Pin Number	Input Signal	Connection for 613 (Horizontal Format)	Connection for 613-1 (Vertical Format)
J701-1	+X Input	J12-4	J12-2
J701-2	−X Input	J12-3	J12-1
J701-15	+Y Input	J12-2	J12-4
J701-16	−Y Input	J12-1	J12-3
J705-1	Slow Ramp	J13-1	J13-1
J705-2	Slow Ramp gnd	J13-2	J13-2
J705-3	Fast Ramp	J13-4	J13-3
J705-4	Fast Ramp gnd	J13-3	J13-4

Deflection Coil Leads

Yellow	J6-1	J6-4
Red	J6-2	J6-2
Blue	J6-3	J6-3
Black	J6-4	J6-1

b. Turn on the 613 Power switch and allow a 20 minute warmup. Connect the leads of the dc voltmeter to ground and to TP68 on the Power Supply board (see Fig. 3-2). Check the meter reading for +15 V, ±1/2% (75 mV). If the reading is not within these limits, adjust R12 on the Power Supply board until the reading is within prescribed limits.

c. Move the meter leads successively to the test points shown in Table 3-2, and check for the voltage readings in the table.

d. Turn off the 613 power.

e. Reconnect the plug to J82 pins 1 and 2.

2. High Voltage Adjustment

a. Set the voltmeter to measure −6000 V or greater. Connect the meter between ground and TP51 on the HV board. See Fig. 3-3 for component location.

b. Turn the INTENSITY control on the 613 rear panel fully counterclockwise. Turn on the 613 Power switch.

c. Check that no spot appears on the 613 display screen.

d. Check for a meter reading of −6000 V ±5% (300 V). If the meter reading is not within prescribed limits, adjust R226 (lowest of 3 potentiometers in the center of the High Voltage and Z-axis board (HV board) to bring it within specification. Remove the meter leads.

3. Writing Gun Bias Adjustment

CAUTION

The crt is easily damaged by high beam intensity. Keep the intensity as low as possible. Watch the display spot during all adjustments.

a. Set the rear-panel FOCUS control to fully defocus the beam.

b. Set the rear-panel INTENSITY control fully counterclockwise (off).

c. Set the Writing Intensity Preset R234 control (center one of the three potentiometers on the HV board) at mid-range.

d. Push the VIEW pushbutton. This procedure is performed in the view mode of operation. The hold mode displays the cursor. Push the VIEW and the ERASE pushbutton as necessary.

e. Advance the INTENSITY control clockwise to barely display the spot on the crt. If the spot does not appear, set the INTENSITY control fully clockwise.

f. Slowly turn R234 to determine the rotation direction that turns off the spot. Set the control in its fully-off position.

g. Set the INTENSITY control fully clockwise (on).

h. Adjust R234 to barely display the spot.

i. Adjust the FOCUS control for a round spot. Adjust R234 to reduce the intensity as necessary.

j. Adjust R234 to barely extinguish the spot with the INTENSITY control fully on.

k. Turn the INTENSITY control fully off.

4. Output Amplifier Adjustments

a. Ground J18 pin 6 on the Deflection Amplifier board to place the hard copy $\overline{\text{READ}}$ line at its true (low) level. See Fig. 3-6 for component location. The ERASE pushbutton is disabled when pin 6 is grounded.

b. Connection of horizontal and vertical input signals to the Deflection Amplifier board (J12 and J13) is easily accomplished by using 1X probes having clip-on tips and ground clips. The probe BNC connector attaches to the signal source. The probe tip and ground clip are the plus and minus signal source respectively. The plugs on the jacks may be removed to allow probe attachment.

Set the Tektronix Standard Amplitude Calibrator for a 0 V to +5 V square-wave. A generator with a 10 V peak-to-peak (zero center) square-wave may be used in place of the Standard Amplitude Calibrator.

Connect the probe tip to J13 pin 4 and the ground clip to J13 pin 3 (613-1: J13 pin 3, J13 pin4 respectively). See Table 3-1 for alternative input connections.

c. Set a sinewave (or sawtooth, zero center) generator for a 10 V peak-to-peak, zero center signal. The signal frequency may be from 60 Hz to 10 kHz but not the same frequency as the square-wave.

Connect the probe tip (from the sinewave generator) to J13 pin 1 and the ground clip to J13 pin 2.

d. Turn the rear-panel HC INTENSITY control fully counterclockwise. Adjust for the desired intensity after completing this step.

CAUTION

High HC INTENSITY settings may cause crt burns.

Remove the connector from J25 on the Deflection Amplifier board and reconnect it in the reverse position.

This turns on the Z-axis amplifier and causes a display (which consists of two parallel lines with one line through the center) to appear.

e. Adjust Long-axis Geometry R402, Long-axis Size R302 and Long-axis Centering R502 (see Fig. 3-6) to make the displayed lines straight, parallel, 21 cm apart and centered on the crt. The 0 V to +5 V square-wave signal may be set for a 10.5 cm separation with one line through the crt center. Switch between +5 V dc and −5 V dc to check for the 21 cm separation.

f. Connect J25 in its normal position.

g. Interchange the Fast Ramp and the Slow Ramp signals.

h. Connect J25 in its reverse position.

i. Adjust Short-axis Geometry R401, Short-axis Size R301 and Short-axis Centering R501 to make the displayed lines straight, parallel, 15.75 cm apart and centered on the crt. The 0 V to +5 V square-wave signal may be set for a 7.875 cm separation with one line through the crt center. Switch between +5 V dc and −5 V dc to check for the 15.75 cm separation.

j. Connect J25 in its normal position, remove the input signals and disconnect the ground lead from J18 pin 6.

5. Input Amplifier Adjustments

a. Set the square-wave generator for a 0 V to +1 V square-wave and connect the probe tip from the generator to both pins 1 and 2 of J12 (common mode connection) (613-1: J12 pins 3 and 4). Connect the ground clip to chassis ground.

b. Apply a 1 volt peak-to-peak sinewave or sawtooth signal at a frequency between 60 Hz and 10 kHz to J12 pin 4 and the ground clip to J12 pin 3 (613-1: J12 pin 2, J12 pin 1 respectively). This signal must not be the same frequency as the square-wave.

c. Set J9 and J10 jumpers in position 2.

d. Set the rear-panel INTENSITY control fully counterclockwise. Reverse the connector on J25 to turn on the Z-axis amplifier. Adjust the INTENSITY to display the signal.

e. Push the VIEW pushbutton and adjust the Long-axis Common Mode control R49 to superimpose the two lines.

f. Disconnect the common mode connection from J12 pins 1 and 2 (613-1: J12 pins 3 and 4). Reconnect the probe tip to J12 pin 2 and the ground clip to J12 pin 1 (613-1: J12 pin 4, J12 pin 3, respectively).

g. Set J10 jumper in position 1.

h. Adjust a Long-axis Input Size control R50 and Long-axis Input Position control R46 to space the lines 20 cm apart and center the display.

i. Place the connector to J25 in its normal position (to turn off the display) and remove the two input signals.

j. Connect the probe tip from the square-wave generator to both pins 3 and 4 of J12 (common mode connection) (613-1: J12 pins 1 and 2). Connect the ground clip to chassis ground. The signal is a 0 V to +1 V square-wave.

k. Apply a 1 V peak-to-peak sinewave or sawtooth signal to J12 pin 2; connect the signal ground clip to J12 pin 1 (613-1: J12 pin 4, J12 pin 3 respectively).

l. Set J10 jumper in position 2.

m. Connect J25 in the reverse position to turn on the display.

n. Push the VIEW pushbutton and adjust the Short-axis Common Mode control R48 to superimpose the two lines.

o. Disconnect the common mode connection from J12 pins 3 and 4 (613-1: J12 pins 1 and 2). Reconnect the probe tip to J12 pin 4 and the ground clip to J12 pin 3. (613-1: J12 pin 2, J12 pin 1 respectively).

p. Set the J9 jumper in position 1.

q. Adjust Short-axis Input Size control R47 and Short-axis Input Position control R45 to space the lines 15 cm apart and center the display.

r. Place the J25 connector in its normal position to turn off the display. Remove the input signals.

6. Axis $\overline{\text{BUSY}}$ Null Adjustment

a. Set the J9 and J10 jumpers in position 2.

b. Connect a dc voltmeter (about 0.6 V full scale) between U315 pin 6 and ground.

c. Adjust R304 for 0 V.

d. Connect the meter to U415 pin 6.

e. Adjust R409 for 0 V.

7. Focus

a. Ground J21 pin 5 (or have the unit in the VIEW mode) to display the cursor. If the cursor is not seen, adjust Cursor Intensity control R240 on the Deflection Amplifier board.

b. Adjust the rear-panel FOCUS control for a sharp dot matrix at the crt center.

c. Set J9 and J10 jumpers for a corner position.

d. Adjust Dynamic Focus control R472 (on the HV board) for a sharp dot matrix.

e. Check all crt positions for a sharp dot matrix.

f. Turn off the beam INTENSITY and remove the ground from J21 pin 5.

8. Storage

a. Push the front panel VIEW and ERASE pushbuttons.

b. Advance the rear-panel OPERATING LEVEL control until the screen starts to store up in the corners. Push ERASE and check as necessary.

c. Measure the voltage at J46 pin 1 on the Storage board (see Fig. 3-4).

d. Adjust the OPERATING LEVEL control to lower the voltage by 25 V.

e. Adjust the Collimation control R103 (on the Storage board) for the brightest, uniform screen background.

Repeat the adjustments until a bright, uniform background is obtained with no storage after erasure.

f. Measure the voltage at J46 pin 2. The voltage normally is 100 V to 110 V. (A voltage less than 100 V requires a higher OPERATING LEVEL setting for optimum storage, which shortens the phosphor life. A voltage greater than 110 V causes weak storage in the corners.)

g. Set J25 to the normal position.

9. Hard Copy

a. Reinstall the emi shield on the crt.

b. Set J24 to normal position and set J9 and J10 to position 1 on the Deflection Amplifier board.

c. Plug the cable from the Hard Copy Unit into J705 on the 613 rear panel. Remove fuse F28 on the 4610 Timing board (see Fig. 3-11). Apply power to both the 613 and the Hard Copy Unit.

d. Preset HC INTENSITY R1030 on the rear panel of the 613 to about the center of the control range.

e. Press the Copy button on the Hard Copy Unit, and as the Hard Copy cursor sweeps the 613 display, turn up

Hard Copy Intensity Preset R241, repeating the operation until the Hard Copy scan begins to store. Then back off R241 to just below the point where the raster stores. (R241 is the top one of three potentiometers near the center of the HV board.) Use HC INTENSITY R1030 for fine adjustment of the Hard Copy scan.

f. Replace the fuse in the hard copy unit.

g. Apply a display to the 613 and make a hard copy. Adjust Hard Copy Threshold R137 to set the desired hard copy contrast. Adjust Dynamic Threshold R134 for uniform contrast. The two controls interact. The two controls are on the Hard Copy board (see Fig. 3-12).

h. Disconnect the J705 plug.

10. Cursor Intensity

a. Ground pin 8 of J701 to place the CURSOR line at ground (true level).

b. Adjust R240 Cursor Intensity (center of Deflection Amplifier board) until the cursor stores. Erase the screen and readjust R240, repeating the procedure until the cursor is just below the storage level.

NOTE

Hard Copy Intensity and Cursor Intensity adjustments interact to some extent so if Hard Copy Intensity has been adjusted, Cursor Intensity may have to be reset, and vice versa.

c. Remove the ground to J701 pin 8.

11. Square Format (613-1 Only)

a. Check that the J11 jumper on the Deflection Amplifier board is connected to pins 1 and 2.

b. Put J10 in position 1 and J9 in position 2.

c. Apply a 0 V to +1 V (±1%) square-wave to J12 pin 4 and the signal ground clip to pin 3. Apply 1 V peak-to-peak sinewave or ramp wave to J12 pin 2 and the signal ground clip to pin 1.

d. Reverse the connector on J25 to turn on the Z-axis amplifier.

e. Adjust Long-axis Input Size R50 to put the displayed lines 15 cm apart.

f. Return J25 connector to its normal position to turn off the beam.

12. Completion

a. Return all jumpers on the Deflection Amplifier board to their normal operating positions (see Fig. 1-4).

b. Connect the panel light and replace the face shield and dust cover.

Section 4

CIRCUIT DESCRIPTION

See Fig. 4-1, which shows the signal relationship of the schematics of the circuits contained in the 613 Storage Display Unit. The circuits are: the Deflection, HC Logic, Cursor and Z-axis Input; the Deflection Amplifiers; the Storage Circuit; the Hard Copy Amplifier; the High Voltage and Z-axis; and the Power Supply.

During write operation, the Deflection, HC Logic, Cursor and Z-axis Input circuit receives the Long-axis and the Short-axis Input signals that control the writing beam deflection. These signals are character or vector writing information from the external signal input source. During hard copy operation, the input signals that are required to read the stored information on the crt are the HCU Fast Ramp, the HCU Slow Ramp, and the HCU INTERROGATE pulses. In writing or hard copy operation, the output signals drive the Long-axis and the Short-axis Deflection Amplifiers. Signal CURSOR enables the Cursor Matrix Generator to generate an eight by eight dot cursor matrix

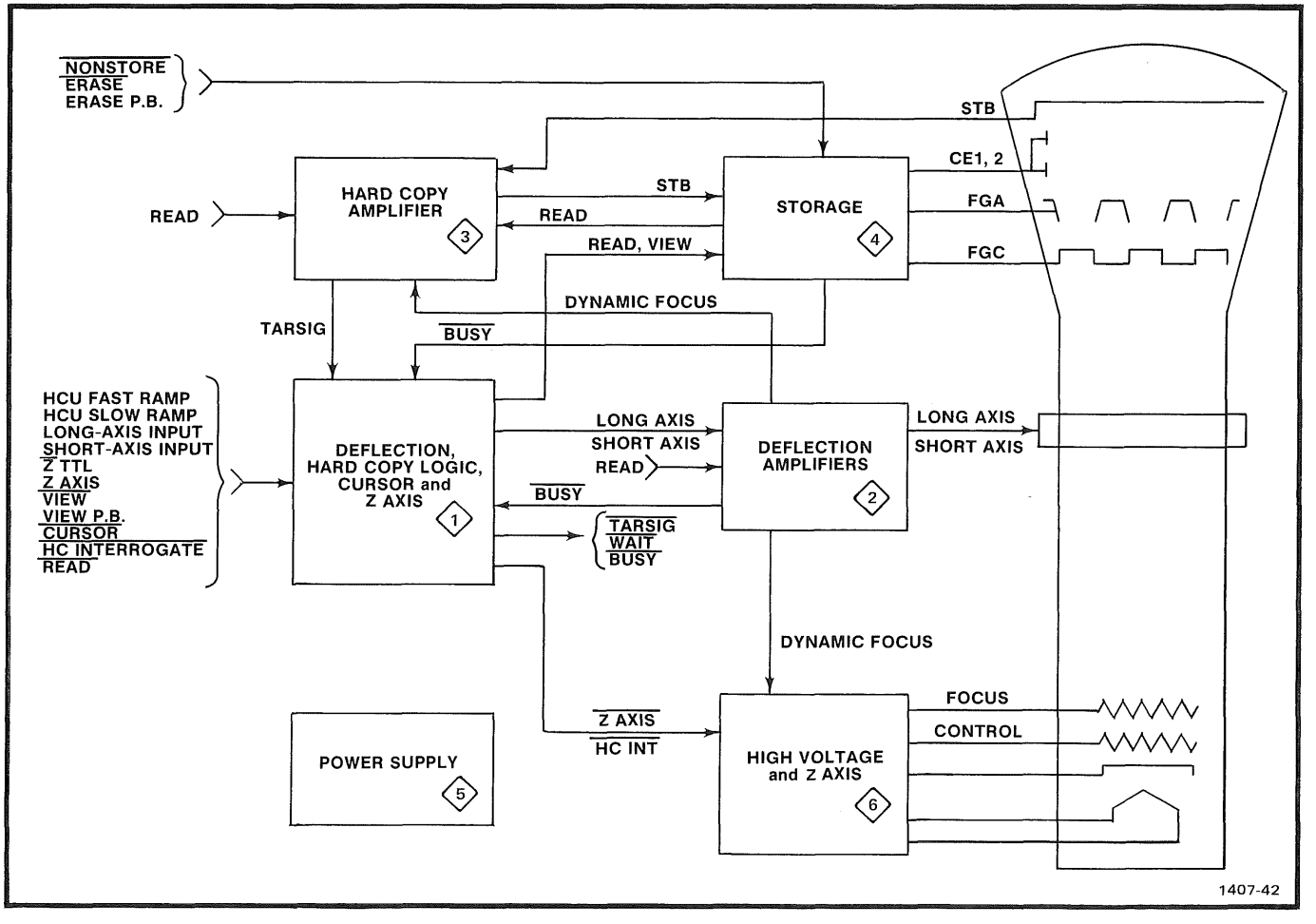


Fig. 4-1. 613 Storage Display Unit block diagram.

that, along with the Z-axis signals displays the beam writing position. The Hard Copy Logic generates the signals required for hard copy operation.

The Deflection Amplifier circuit amplifies the Long-axis and the Short-axis Deflection Amplifier Signals to provide the drive signals to the crt Long-axis and Short-axis Deflection coils. The amplifier also generates the DYNAMIC FOCUS signal that corrects for deflection and focus error due to the beam displacement away from the crt center. The DYNAMIC FOCUS signal is sent to the High Voltage and Z-axis circuit and the Hard Copy Amplifier. The Hard Copy Amplifier uses the signal to provide more uniform copying sensitivity throughout the display.

The Storage circuit generates signals for the collimation electrodes, the flood gun anodes and cathodes, and the storage backplate.

The Hard Copy Amplifier amplifies and processes the storage backplate signal during hard copy operation to generate signal TARSIG, which goes to the Deflection, HC Logic, Cursor, and Z-axis circuits.

The High Voltage and Z-axis circuit generates the high voltage for the crt cathode and control grid. It also provides the crt focus signal. The $\overline{\text{Z AXIS}}$ input signal is amplified and drives the control grid. The beam intensity for writing or for hard copy operation is selected by input signal $\overline{\text{HC INT}}$.

The Power Supply supplies low voltage power to all circuits.

DEFLECTION, HARD COPY LOGIC, CURSOR AND Z-AXIS INPUT

Block Diagram Description

Refer to the block diagram of Fig. 4-2. The circuit is composed of the Long-axis Preamplifier, the Short-axis Preamplifier, the Origin Shifter, the Cursor Generator, the VIEW Generator and the $\overline{\text{Z AXIS}}$ Generator.

The Long-axis Preamplifier processes either the Hard-copy Fast Ramp input signal or the Long-axis input signal from the signal source. The Short-axis Preamplifier processes either the Hard-copy Slow Ramp input signal or the Short-axis input signal from the signal source. The hard-copy signals are selected when $\overline{\text{READ}}$ is low. The Long- and Short-axis signals are selected when $\overline{\text{READ}}$ is high.

The Origin Shifter moves the cursor home (origin) position (each time the ERASE button is pushed) to prevent crt burn.

The Cursor Generator generates the eight-by-eight dot pattern that indicates the writing beam's position, generates the $\overline{\text{Z AXIS}}$ signal required by the cursor, and provides hold mode signals for the View Signal Generator.

The View Signal Generator generates $\overline{\text{VIEW}}$ when the VIEW button is pushed or when commanded by internal or remote $\overline{\text{VIEW}}$ signals. VIEW drives the View Control circuit on the Storage board.

The Z-axis Signal Generator generates control signal $\overline{\text{Z AXIS}}$ for the Z-axis Signal Amplifier.

Circuit Description

Long-axis Preamplifier. Refer to the Deflection, Hard Copy Logic and Z-axis Input schematic. The circuit is composed of U162 and U152. It shares with the Short-axis Preamplifier a switch that is composed of Q271, U371F and U371B. In hard-copy operation, input signal $\overline{\text{READ}}$ is low and puts a high (about +15 V) at Q271 collector to turn on CR262 and turn off CR72. The high signal through CR262 is inverted by U152 to turn off CR263. This inhibits U152 from outputting any signals from its input source. Since CR72 is turned off and CR271 is turned on, U162 is enabled to pass the hard-copy unit fast ramp signals, which go to the Long-axis Deflection Amplifier.

The positive excursion of the output signal at J14-1 is limited to about 1.2 V by CR273 and CR78 to prevent Deflection Amplifier overcurrent.

Long-axis Origin Selector J10 sets the no-input signal location. (Fig. 1-5 explains the J10 and J9 strap positions and their effect.)

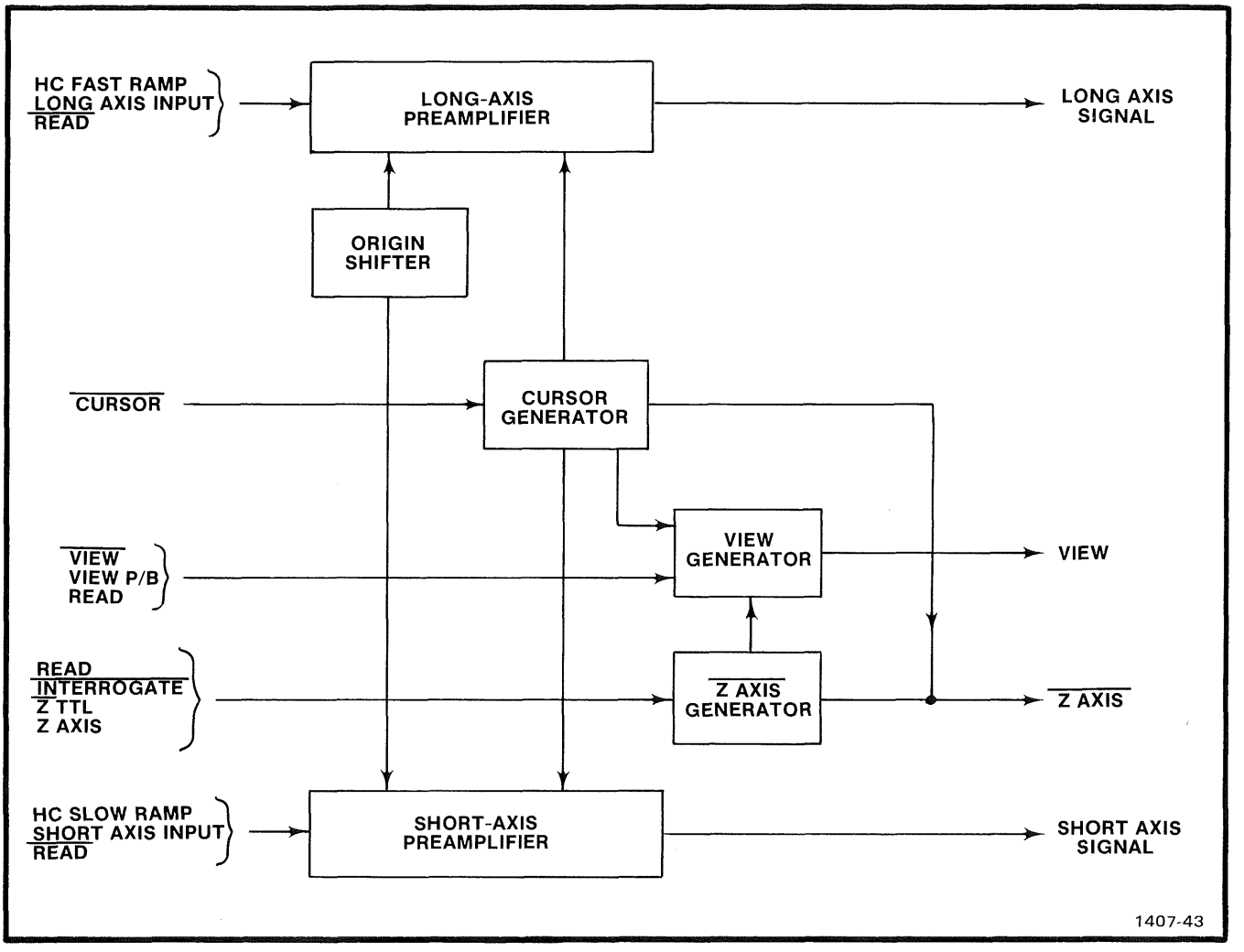


Fig. 4-2. Deflection, HC Logic, Cursor and Z-axis Input simplified block diagram.

The gain of U152 can be set by R50 and jumper on J11. J11-2 and J11-3 are connected together for the 613. J11-2 and J11-1 are connected together for the 613-1 (to limit the deflection to 15 cm).

Long-axis Input signals greater than 1 V require different values for R70 and R71 and the addition of a resistor (shown with broken-line connections) that is connected between the resistors.

Short-axis Preamplifier. The circuit is composed of U161 and U151. The input signal is either the hard-copy unit slow ramp or the Short-axis input. The output signal goes to the Short-axis Deflection Amplifier. The action of this circuit is like that of the Long-axis Preamplifier.

Cursor Generator. The circuit contains a pulse generator and a cursor matrix generator that is clocked by the pulse generator. The pulse generator is composed of monostable multivibrators U342A and B that are connected to form a free-running multivibrator when the $\overline{\text{CURSOR}}$ signal through U343F and B to U343A (or the enabling signal, about 90 s duration, from U353B pin 12 via U343A) is present. U342A sets the period between pulses and U342B sets the pulse duration (which is controlled by cursor intensity control R240). The greater the pulse width, the brighter the cursor.

The cursor matrix is generated by U444, U545 and U553. U444 and U545 are four-bit binary counters that have a count weight of 1, 2, 4 and 8 at pins 12, 9, 8 and 11 respectively. The clock input is pin 14. The count is reset to zero if pins 2 and 3 are both high. U545 is clocked by the low-going output signal from U444 pin 11.

U444 pins 8 and 11 and U545 pin 12 output signals (through their respective inverters and resistors) generate an eight step, negative-going staircase signal at the point labeled X. This signal also goes to the X input of R255 (near J10 on the top of the schematic) to drive U152 pin 3 through a resistor network. U545 pins 8, 9 and 11 output signals (through their respective inverters and resistors) generate an eight step negative staircase signal at the point labeled Y. This signal goes to the Y input of R252 (near J9 on the top of the schematic) to drive U151 pin 3 through a resistor network. These signals provide the cursor matrix X- and Y-deflection signals to the appropriate deflection amplifiers.

The cursor matrix is generated by completing one X staircase for each step decrement of the Y staircase. The dot path is from right to left and from top to bottom of the square matrix cursor. A $\overline{\text{Z AXIS}}$ signal is required to display each dot. This signal is generated by U444, inverters U343C, D and E, and U361C. The inverters are of the open-collector type and therefore may be used to form a wired AND gate by connecting their outputs together. When U361C is enabled by an inverted $\overline{\text{CURSOR}}$ signal to pin 10, it outputs a pulse as a result of every fourth clock pulse from U342B, when the pin 9 input to U361C is permitted to go high. Each X step is four clock periods in duration, so there is one dot per step. The binary counters are reset by a high signal from either U471D or C. U471D generates a high if pin 13 is high (no $\overline{\text{CURSOR}}$ signal) or if pin 12 is low (has a $\overline{\text{READ}}$ signal). U471C generates a high if pin 9 receives a $\overline{\text{VIEW}}$ signal or pin 10 gets an inverted VIEW signal from timer U353B.

U443B outputs about a 90 Hz pulse with about a 12% duty cycle that goes through U443A in the View Signal Generator when operating in the hold mode (when the stored brightness is reduced to prolong the crt life). This signal modulates the flood gun anode.

Origin Shifter. The circuit is composed of the four-bit binary counter U79 and inverters U179A, B, C and F. Each time the Fade Positive Multivibrator in the Storage circuit is triggered by an erase signal, the multivibrator outputs a high signal to U79 pin 1 to increment its count. If an inverter output is high, its supplies current to the Long- and Short-axis Preamplifiers. The binary count determines the total output current. Since the same amount of current goes to each axis, the home position of the beam is slightly shifted along a diagonal to one of the eight beam origin positions. The beam origin positions are repeated every eight erasures.

VIEW Generator. The circuit is composed of Q451, U353B, U471B and U443A. The VIEW pushbutton signal, through U471B pin 5, triggers monostable multivibrator U353B. Output pin 12 goes low for about 90 seconds and drives U443A pin 1 to generate signal $\overline{\text{VIEW}}$. The $\overline{\text{Z AXIS}}$ signal from J25-1 to U471B pin 4 also triggers the multivibrator. Signal $\overline{\text{VIEW}}$ from U443A also occurs under any of the following conditions: when pin 2 receives signal $\overline{\text{VIEW}}$ from the remote program input (J701-20), when pin 4 receives the hold-mode signal from U443B in the Cursor Generator, or when pin 5 receives a $\overline{\text{WAIT}}$ command, which originates in hard copy units that are equipped with a multiplexer option.

$\overline{\text{Z AXIS}}$ Generator. The generator is composed of Q476, Q572, U571B, U361A, B, C and U353A. Signal $\overline{\text{Z AXIS}}$ at J25-1 may come from U361A, B or C. The signal from U361C is described in the Cursor Generator. The signal from U361A occurs when monostable multivibrator U353A is enabled by an inverted $\overline{\text{READ}}$ signal to pin 2 and is triggered by $\overline{\text{HCU INTERROGATE}}$ to pin 1. The signal from U361B requires a Z TTL input signal through U571B or a Z AXIS input signal through Q476, Q572 and U571B pin 9. The transistors shape and convert the input signal to TTL level. Gate U361B is inhibited by the $\overline{\text{CURSOR}}$ signal through U343F and U371C or by the $\overline{\text{READ}}$ signal through U371B and U371E.

Addenda

Output signals not previously described are: $\overline{\text{TARSIG}}$, $\overline{\text{BUSY}}$ and $\overline{\text{HC INT}}$. Signal $\overline{\text{TARSIG}}$ from U361D occurs when signals $\overline{\text{TARSIG}}$ and $\overline{\text{READ}}$ are coincident.

Signal $\overline{\text{BUSY}}$ comes from either the Erase BUSY Generator in the Storage circuit or from the Deflection $\overline{\text{BUSY}}$ Generator in the Deflection Amplifier. The signal goes to J701-7.

Signal $\overline{\text{HC INT}}$ is signal $\overline{\text{READ}}$ via U371B and E. The signal switches the Z-axis control circuit to hard copy intensity during hard copy operation.

DEFLECTION AMPLIFIER

General

The Deflection Amplifier circuit receives horizontal (H) and vertical (V) analog voltages and amplifies them to provide the drive signals to the H and V deflection coils. This circuit also generates a dynamic focus signal, which is used in the high-voltage circuit, and a 613 $\overline{\text{BUSY}}$ signal, which can be used to control external devices.

The 613 is manufactured in two models, the 613 and the 613-1. The display area of the 613 has its long axis oriented horizontally and its short axis vertically. The opposite is true with the 613-1. Thus, with the 613, the X input (horizontal) is connected to the Long-axis Amplifier, and the Y input (vertical) is connected to the Short-axis Amplifier. Again, the opposite situation is true with the 613-1. In the discussion which follows, the instrument is considered to be a 613. References to the H signal imply the Long-axis Amplifier, and those to the V signal refer to the Short-axis Amplifier.

Block Diagram Description

Refer to the block diagram in Fig. 4-3. The circuits making up the deflection amplifiers are the Long-axis Absolute Value Amplfiier, the Short-axis Absolute Value Amplifier, the H^2 and V^2 Multipliers, the $H^2 + V^2$ Amplifier, the Long-axis Geometry Multiplier, the Short-axis Geometry Multiplier, the Long-axis Deflection Amplifier, the Short-axis Deflection Amplifier and the $\overline{\text{BUSY}}$ Generator.

The H and V signals are each applied to three circuits within the deflection amplifiers. The H signal goes to the Long-axis Absolute Value Amplifier to generate a positive output signal, regardless of the polarity of the H Input signal. Then it is squared by the H^2 Multiplier and applied to the $H^2 + V^2$ Amplifier. It is combined with the signal from the V^2 Multiplier to develop the Dynamic Focus signal, which goes to the Long-axis Geometry Multiplier, the Short-axis Geometry Multiplier, and also to the Focus Supply and Hard Copy Amplifier circuits. The H input signal is also applied to the Long-axis Geometry Multiplier circuit, where it combines with the Dynamic Focus signal to generate an H Geometry signal. The H signal, H Geometry signal and a feedback signal from the Long-axis Deflection Amplifier combine at the summation point at the input to the Long-axis Deflection Amplifier. The output of the Long-axis Deflection Amplifier provides the drive for the Long-axis Deflection coil. The Short-axis Deflection Amplifier circuit functions in a similar manner.

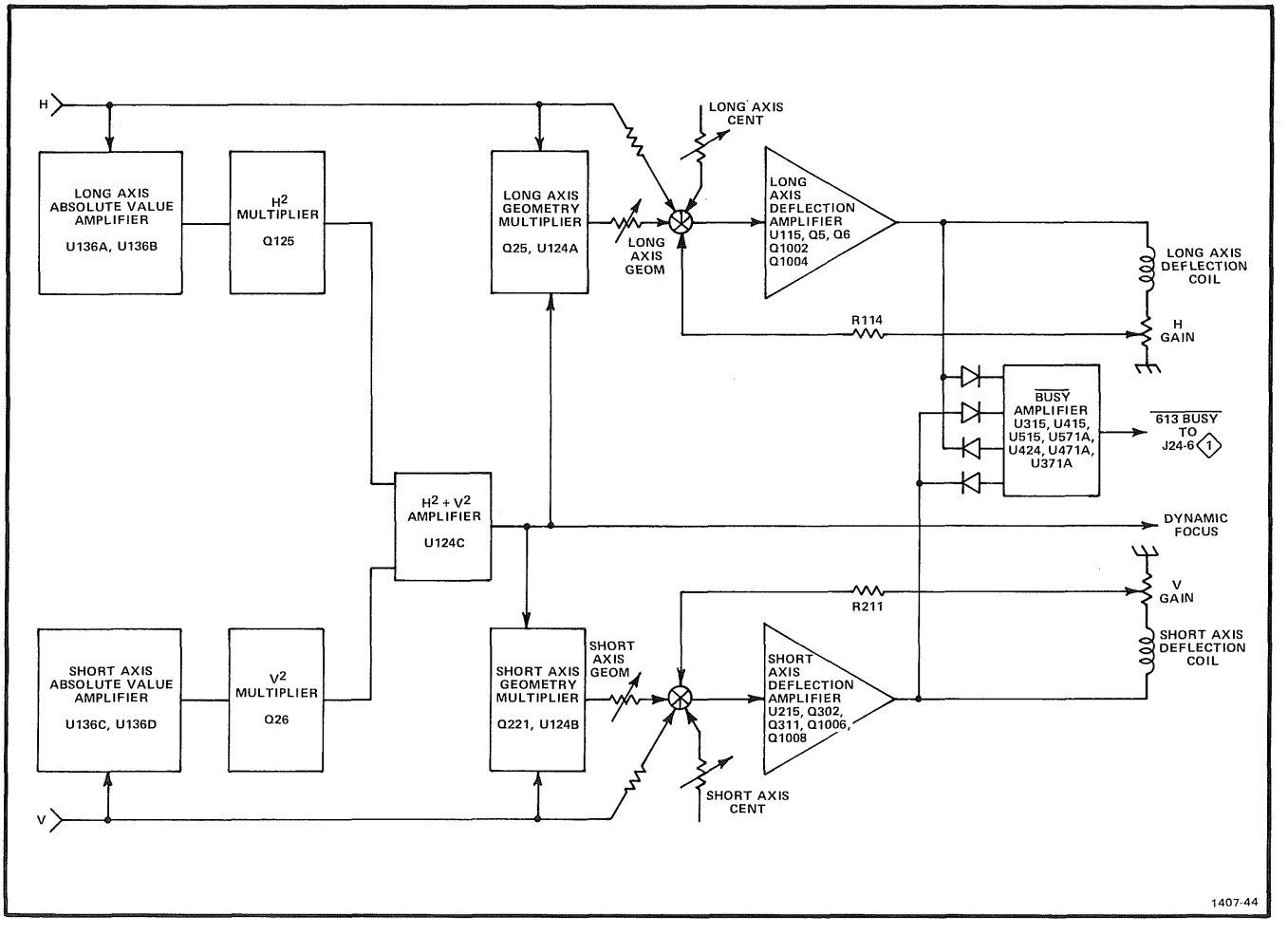


Fig. 4-3. Deflection Amplifier Block Diagram.

Circuit Desciption

Refer to the Deflection Amplifier schematic. Because of the similarity between the Long-axis circuitry and the Short-axis circuitry only the Long-axis circuits will be explained here.

Long-axis Absolute Value Amplifier. The Long-axis Absolute Value Amplifier consists of two operational amplifiers, each of which has one input referenced to ground. If a negative signal is applied, U136A develops a positive going output which back-biases CR133 and forward-biases CR132, permitting the signal to be supplied to the emitter and base of Q125. The negative signal is simultaneously applied to the positive input of U136B, causing its output to go negative. CR232 is back-biased, preventing the signal from affecting the output. CR233 is forward-biased, permitting feedback to pin 6 to offset the input signal. If the H input goes positive, U136B develops a positive output, forward-biasing CR232 and transmitting the signal to Q125, which is the H^2 Multiplier. The positive signal applied to U136A causes its output to go negative, back biasing CR132 and forward biasing CR133, holding pin 2 at ground potential.

H^2 Multiplier. H^2 Multiplier Q125 is cut off under no-signal conditions. Positive voltages applied to R323 cause the transistor to conduct. However, the same positive voltage being applied to R323 is also applied to the R232-R231 voltage divider. This causes the current through one side of Q125 to be less than through the side which has its base grounded. The amplitude difference between output signals taken from the collectors of Q125 is proportional to the square of the input voltage. They combine with the signals from Q26 in the V^2 Multiplier, with the resultant signal being applied to the inputs of U124C of the $H^2 + V^2$ Amplifier.

$H^2 + V^2$ Amplifier. $H^2 + V^2$ Amplifier U124C is an operational amplifier that develops an $H^2 + V^2$ output signal, which drives the emitters of Q25 in the Long-axis Geometry Multiplier and the emitters of Q221 in the Short-axis Geometry Multiplier. The output signal from U124C is a Dynamic Focus signal, which also goes to the Focus Supply in the High Voltage circuit (to correct for changing focal length as the beam moves away from the crt center) and to the Hard Copy Amplifier.

Long-axis Geometry Multiplier. The Long-axis Geometry Multiplier is composed of differential amplifier Q25 and operational amplifier U124A. Both emitters of Q25 receive the Dynamic Focus input signal and the base of Q25A receives the H-input signal. The differential output signal from the collectors of Q25 drive the operational amplifier. The output signal from the geometry correction control (R402) inputs a correction current to U115 in the Long-axis Deflection Amplifier. This current corrects the linearity of the crt display as the beam is deflected away from the crt center.

Long-axis Deflection Amplifier. The Long-axis Deflection Amplifier is composed of U115, Q5, Q6, Q1002 and Q1004, which form an operational amplifier with R114 being the feedback resistor. The input signals are summed at U115 pin 3. The inputs are the long-axis input signal from R111, the centering signal (a level) from R112 and the geometry correction signal from R113. The output signal from Q1002 and Q1004 emitters drive the long-axis deflection coil of the crt.

U115 is an operational amplifier with feedback diodes CR16, CR17, CR114 and CR115. The ac gain of U115 is reduced to unity when the pairs of diodes conduct as the signal at pin 6 exceeds about ±1.2 V. The decreased gain reduces the amplifier settling time since the amplitude of the output signal overshoot is limited.

A negative signal at U115 pin 3 creates a positive signal at the collector of Q6, which increases the drive to Q1002 to increase the current through the long-axis coil (at the junction of R104A and R104B). At the same time, the positive signal at the collector of Q6 decreases the drive to Q1004. The current through Q1004 decreases to compensate for the increase through the long-axis deflection coil. A positive signal at U115 pin 3 turns off Q6 and Q1002 and allows the current from Q5 to turn on Q1004. The junction of R104A and R104B goes negative. Under no-signal conditions, with the Origin Jumper in its center position, the junction of R104A and R104B is at zero volts and there is no current through the coil.

Q403 and Q5 form a constant current source. Q16 is a current source for Q6.

Deflection $\overline{\text{BUSY}}$ Generator. The Deflection $\overline{\text{BUSY}}$ Generator is composed of U315, U415, U515, U571A, U471A and U371A.

A signal change across either the long- or short-axis deflection coils will result in a 613 $\overline{\text{BUSY}}$ signal being available to control external devices. The 613 $\overline{\text{BUSY}}$ signal will be available for the duration of the signal change and

for 10 μs afterwards. The low 613 $\overline{\text{BUSY}}$ (true) signal will occur during hard copy time, when deflection amplifiers are slewing and not yet settled, and during erase time to stop additional input signals until the beam catches up[1].

The signal change across the deflection coil is applied to the appropriate operational amplifier (U315 or U415) inputs. The null adjustment for each axis matches the deflection coil impedance for a balanced operational amplifier input with no signal change. The output of the operational amplifier is applied through one of four diodes (CR503, CR504, CR505, or CR507) depending upon its polarity and from which operational amplifier (U315 or U415) it originates. The output of the diode bridge is then applied to either the + or − input of U515, depending upon polarity. The high output of U515 (which is limited to about +5 V by CR501 and VR512) is inverted by U571A and coupled to monostable multivibrator U424B and U471A; U371A inverts the U471A output. The low output of U571A has no effect on U424B; however, when the input to U424B is released it creates an additional 10 μs low at the input to U471A to continue the $\overline{\text{BUSY}}$ line low.

HARD COPY AMPLIFIER CIRCUIT DESCRIPTION

Refer to the Hard Copy Amplifier schematic. During hard copy operation, the Hard Copy Amplifier monitors the STB (storage target backplate) current. This current reflects whether a written or non-written area is being scanned. The output signal, TARSIG, goes to the Deflection HC Logic, Cursor and Z-axis Input board. The storage target backplate (STB) signals are coupled through T21 and applied to differential amplifier U31, which has a gain of approximately 400. Its output is amplified by approximately 10 in U41, and is applied to comparator U51. U51 provides a negative output pulse in response to STB signals of an amplitude determined by threshold potentiometer R137, which permits the voltage at the positive input of U51 to be set between 0 and +3.3 volts. The U51 output pulses are applied to one-shot multivibrator U251, which responds by generating a positive-going TARSIG pulse whose duration is determined by U251.

The dynamic focus signal is coupled into the threshold circuitry of U51 to dynamically change the threshold as the storage target backplate is being scanned by the hard copy unit to provide more uniform copy.

[1]There are jumpers to select 613 $\overline{\text{BUSY}}$ to go low true for deflection amplifier slewing (J26, which normally is not used) and for Hard Copy (J24).

Q240 and its associated circuitry make up a −5 volt regulator circuit.

STORAGE CIRCUIT

Block Diagram Description

Refer to the block diagram of the storage circuit shown in Fig. 4-4. The circuit controls the storage and erasure of data on the face of the crt. The storage circuit consists of the following sections: The Fade Positive Multivibrator, the Erase Multivibrator, Storage Backplate Amplifier, Erase $\overline{\text{BUSY}}$ Generator, Collimation Electrode Amplifier, and View Control.

After the $\overline{\text{ERASE}}$ pulse, the output voltages are at the levels shown at the left in the waveform diagram in Fig. 4-5. When a VIEW signal is received, the flood gun anode voltage goes positive, permitting stored information to become bright enough for viewing on the crt. Data can then be written.

When the $\overline{\text{ERASE}}$ signal goes low (true), it causes the crt face to become faded positive, causing storage to occur over the entire screen. Immediately following this, the storage backplate voltage is lowered to a point where all stored data erases. The sequence which causes this starts with the low-going $\overline{\text{ERASE}}$ signal arriving at the Fade Positive Multivibrator. This causes a low pulse of about 12 milliseconds to go to the View Control circuit, causing the flood Gun Anode and Cathode to decrease their voltage by approximately 150 volts as shown in the waveform diagram. Thus, the screen is caused to fade positive. During the erase cycle, the 613 $\overline{\text{BUSY}}$ line is low (true). 613 $\overline{\text{BUSY}}$ is applied to the Fade Positive Multivibrator to inhibit erase triggers until the erase cycle is completed.

When the 12 millisecond pulse from the Fade Positive Multivibrator ends, the flood gun anode and cathode voltages from the View Control Circuit return to their quiescent value. The positive transition triggers the Erase Multivibrator, causing the Collimation Electrode voltage to drop to a value below that which occurs at quiescence. At the same time, the Erase Multivibrator causes the Storage Backplate Amplifier to drive the Storage Backplate voltage to zero, from where it rises exponentially toward its previous voltage.

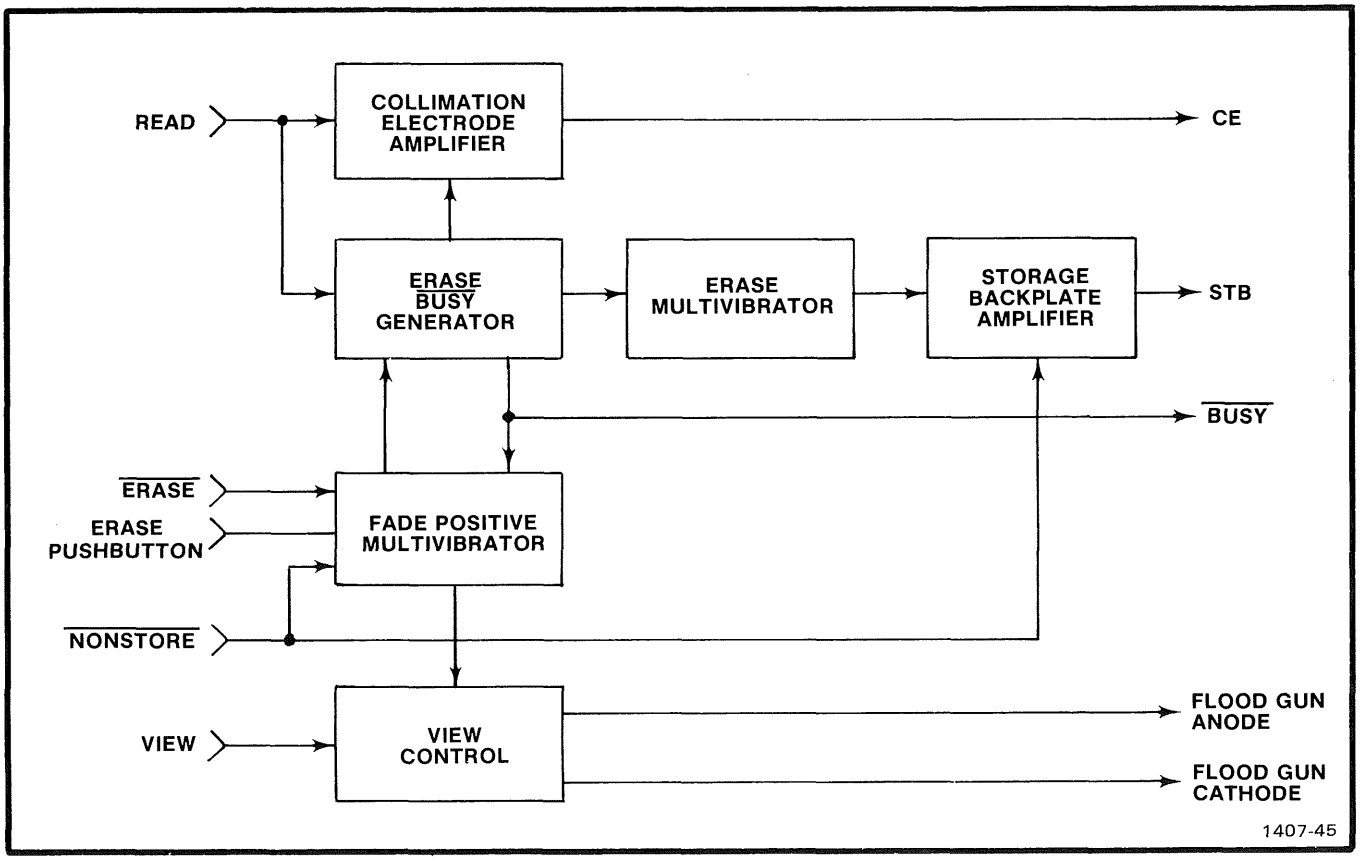


Fig. 4-4. Storage Circuit Block Diagram.

Refer to the waveform diagram. The negative-going voltage pulse on the Flood Gun Anode and Cathode cause fading positive of the crt faceplate, providing uniform storage over the entire area. After the 12 millisecond fade positive pulse elapses, the collimation electrode drops to a value lower than quiescence. At the time that the Flood Gun Anode and Cathode voltage pulse ends, the Storage Backplate voltage goes to zero momentarily and then ramps back toward its operating level to erase the face of the crt. 900 milliseconds later, the Storage Backplate voltage has returned to normal, the Collimation Electrode voltage returns to its quiescent level about 500 ms after the end of the erase pulse, and the $\overline{613\ BUSY}$ signal goes high (false), indicating that erasure has been completed.

Circuit Description

Erase Multivibrator and Storage Backplate Amplifier. These two circuits (see schematic), which determine the backplate voltage, will be discussed first. Quiescently C232 in the Erase Multivibrator (Q135 and Q27) is discharged. The negative side of C232 and the base of Q135 are held by CR233 at −0.7 V. With Q135 held in conduction, its emitter is at about 0 volts. Storage Backplate Amplifier (Q141, Q151, Q153), biasing resistors, and feedback resistor R142, constitute a feedback amplifier with input currents from R242 via current divider R1010, R243, R244 and (during erasure cycle) R140. With Op Level control R1010 at mid-position, about 1/3 milliampere flows into the feedback amplifier and through feedback resistor R142. Multiplying this 1/3 milliampere by the R142 value (499 kΩ) provides approximately +166 volts at the amplifier output, the emitter of Q153. The amplifier output is applied to the Storage Backplate of the crt.

After the $\overline{ERASE}$ signal has been applied to U524 in the Fade Positive Multivibrator and the 12 millisecond multivibrator pulse ends, the output of gate U532B in Erase $\overline{BUSY}$ Generator goes high. U532B output going high is the result of U324 (about 300 millisecond) multivibrator pulse remaining high. The high at U532B output pulls the plus end of C232 to +10 V; the capacitor, not being able to charge instaneously, pulls the base of Q135 to +10 V. Emitter follower Q135 going high cuts off most of the input current to the feedback amplifier, dropping its output voltage to +40 volts above ground. The emitter of Q27 at the same time goes to +10 V and the current via R140 to the feedback amplifier drives the amplifier output to 0 volts.

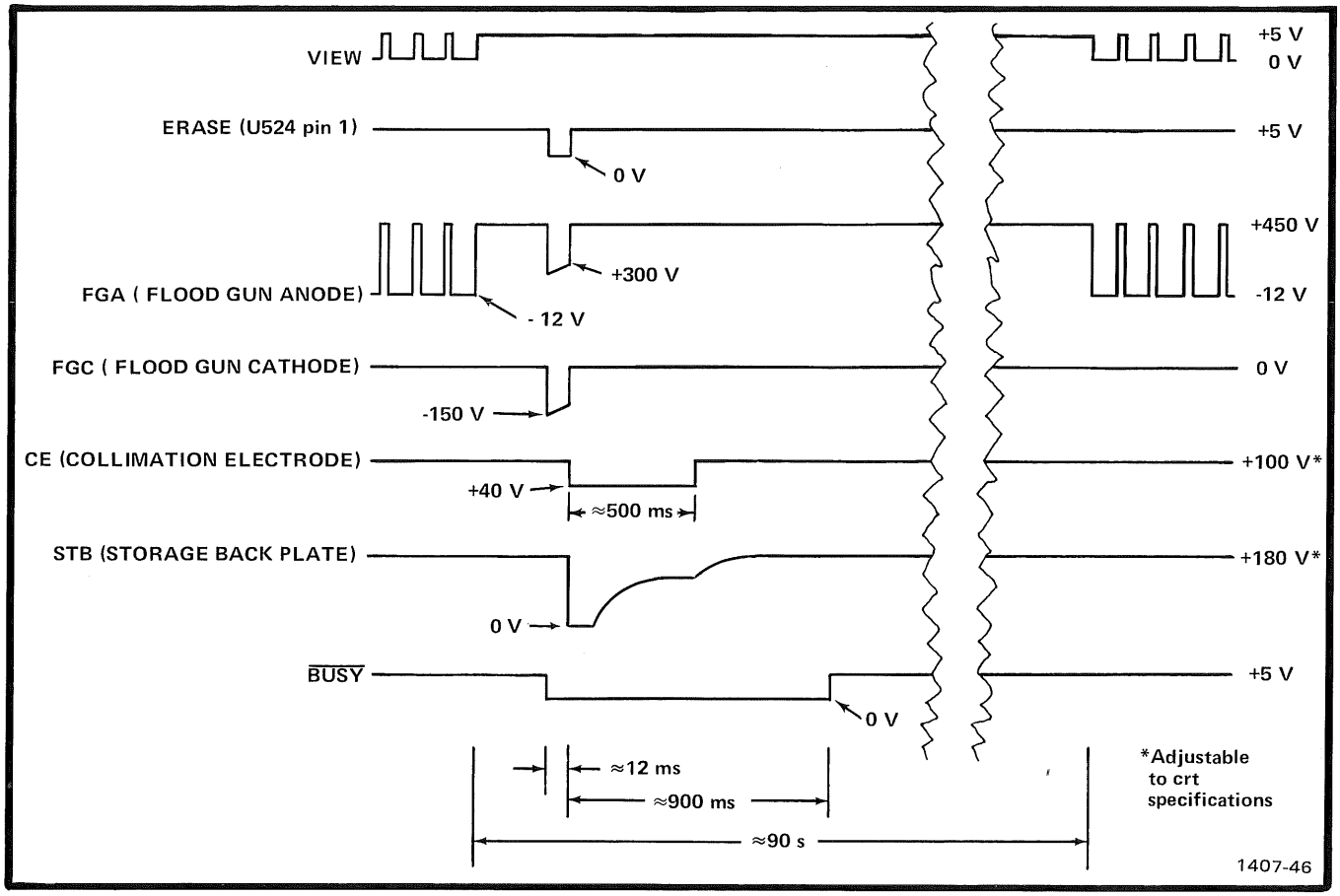


Fig. 4-5. Storage Circuit waveforms.

During the next ≈250 ms, C232 charges exponentially, lowering the emitter follower (Q135) output voltage and applying more current via R242 to the feedback amplifier, raising its output voltage to +166 V, less 40 V due to Q27. After approximately 550 milliseconds, the output of U532B goes low and C232 becomes discharged. The emitter of Q27 drops back to 0 V and the current via R140 to the feedback amplifier decreases to zero exponentially due to the discharging of C235 to 0 V. When this happens, the Storage Backplate voltage has been returned to its quiescent level.

Note that while 613 $\overline{\text{BUSY}}$ is low, $\overline{\text{ERASE}}$ pulses are gated out from affecting U524 by the low from U532A, inhibiting any input to U524 until erasing has been completed.

Collimation Electrode Amplifier. This amplifier consists of transistors Q101, Q102, Q103, Q111, Q1010, Q1012, feedback resistor R212, and input resistor R211. It also includes switchable input resistor networks R4-R104 and R206-R205-R103, which are controlled by Q101 and Q103.

During quiescent operation Q101 is on and Q103 is off. Input current to the feedback amplifier is derived from R221 and input circuit R206-R205-R103. R103 adjusts the amplifier output voltage from +35 V to +120 V.

During the target recovery portion of the erase cycle, both Q103 and Q101 are on and the output of the collimation amplifier is at +35 volts, since the input current for the amplifier comes from only R211.

During hard copy operation, the READ line is high (true), Q103 is on and Q101 is off and the output of the collimation amplifier is set at +240 volts by the input network of R104-R4-R211.

View Control Circuit. The View Control circuit (U432C, Q121, Q131, Q132, Q31, Q53 and Q253) quiescently holds the Flood Gun Cathode at approximately zero volts and the anode at about 450 volts. Zener diodes VR21, VR121 and VR231 conduct to turn on Q53 and Q253. Approximately +450 volts is applied to the anode of the flood guns. Since U524 (in the Fade Positive Multivibrator) has its output high under quiescent conditions, U432C delivers a low to the base of Q121, holding that transistor cut off. Zener diode VR132 conducts and causes +150 volts to be placed on the positive plate of C12. With the anode of CR222 very near ground potential, C12 charges to approximately 150 volts.

When an $\overline{\text{ERASE}}$ signal is received, the output of U524 goes low, causing U432C to deliver a high to the base of Q121. This transistor conducts and places the positive plate of C12 near ground potential. With the positive plate going negative by 150 V, the right plate is driven negative by an equal amount, placing a −150 V signal on the cathode of the flood guns. Since VR21, VR121 and VR231 are still conducting, the voltage on the base of Q53 drops to +300 V. The emitter of Q53 and the crt flood gun anode are thus caused to change in step with the crt flood gun cathode voltage. After the 12 ms pulse from U524 elapses, the voltages return to their previous levels, 0 to +450 volts. This action causes the storage target to appear more positive with respect to its cathode by 150 volts; thus, the target becomes fully written.

Under viewing conditions, the VIEW signal is high, holding Q132 cut off, which holds Q131 and Q31 cut off. However, when the viewing period has elapsed and the VIEW signal goes low, Q132 goes into conduction, causing Q131 and Q31 to conduct. This back-biases CR31 and places approximately −15 volts on the base of Q53. The Q53 emitter voltage and flood gun anode voltage drop to about −15.6 V, turning the flood gun off and dropping the crt flood-gun intensity below viewing level. During the hold mode, the anode is pulsed on at a rate such that data written on the storage target will be retained without loss.

Erase BUSY Generator. The generator is primarily composed of multivibrators U324 and U424A with inverters U432A and B. The other components are gate U532B and inverters U432B and D.

The Fade Positive Multivibrator signal (a low) to U324 pin 3 puts pin 6 high for about 300 ms. The signal is inverted by U432A which outputs the erase $\overline{\text{BUSY}}$ signal. When U324 resets, then U424A is triggered by the high to pin 2. U432B outputs about 600 ms more of signal $\overline{\text{BUSY}}$ so that the total duration of the signal is about 900 ms. Signal $\overline{\text{BUSY}}$ disables the Fade Positive Multivibrator via U532A to prevent retriggering the Erase Multivibrator. Signal $\overline{\text{BUSY}}$ also goes to J701-7.

During the first 300 ms of signal $\overline{\text{BUSY}}$, enabled gate U532B outputs a high when the Fade Positive Multivibrator resets. The high signal from U532B triggers the Erase Multivibrator and, via CR544, CR542 and U432D generates a signal low to turn on Q103 in the Collimation Electrode Amplifier. Signal READ, via U432E, also turns on Q103 during hard copy operation.

J24 in the HCU Busy position causes signal $\overline{\text{BUSY}}$ to be true when the 613 is being hard copied.

LOW-VOLTAGE POWER SUPPLY CIRCUIT DESCRIPTION

Refer to the Power Supply schematic. The supply contains full-wave rectifier supplies of +25 V and −25 V. Full-wave bridge rectifier supplies are connected in series with the +25 V output to supply +350 V and +550 V outputs. The +350 V transformer center tap supplies +175 V. These supplies are unregulated.

+15 Volt Supply

A +15 V regulated supply circuit is composed of operational amplifier U11, series pass regulator Q1016 and driver Q23, over-current detector Q24. If the regulated voltage starts to go low, the signal is fed back through divider network R21, R12 and R11 to U11 pin 2 (minus input). The U11 pin 3 (plus input) voltage is set by Zener VR2. The difference of the two input voltages is amplified and inverted by U11. The low input signal is inverted by U11 and sends a high through Q23 and Q1016 to raise the output voltage. During overload conditions, excessive current through R24 turns on Q24, which reduces the drive to Q23 and Q1016 thus limiting the current.

−15 Volt Supply

The −15 V regulated supply is composed of U64, Q62, Q51 and Q1020. R65 is connected to the +15 V reference and R64 is connected to the −15 V output. The regulator action is similar to the +15 V regulator action.

+5 Volt Supply

The +5 V regulator consists of integrated circuit U1018. When supplied with 12 V, it will output +5 V.

Flood-gun Heater Supply

The flood-gun heater power supply is composed of Q42, Q1022 and VR42. The 26 V supply is Zener referenced to the −25 V supply. The voltage drop across the Zener diode and the emitter-base junctions of Q42 and Q1022 set the emitter of Q1022 at about 26 V positive with respect to terminal J70-8.

HIGH VOLTAGE AND Z AXIS

Block Diagram Description

Refer to the block diagram of Fig. 4-6. The H V Oscillator is a blocking oscillator that provides ac voltage to the primary of transformer T111. The H V Supply outputs −6000 V for the crt cathode. The Focus Supply

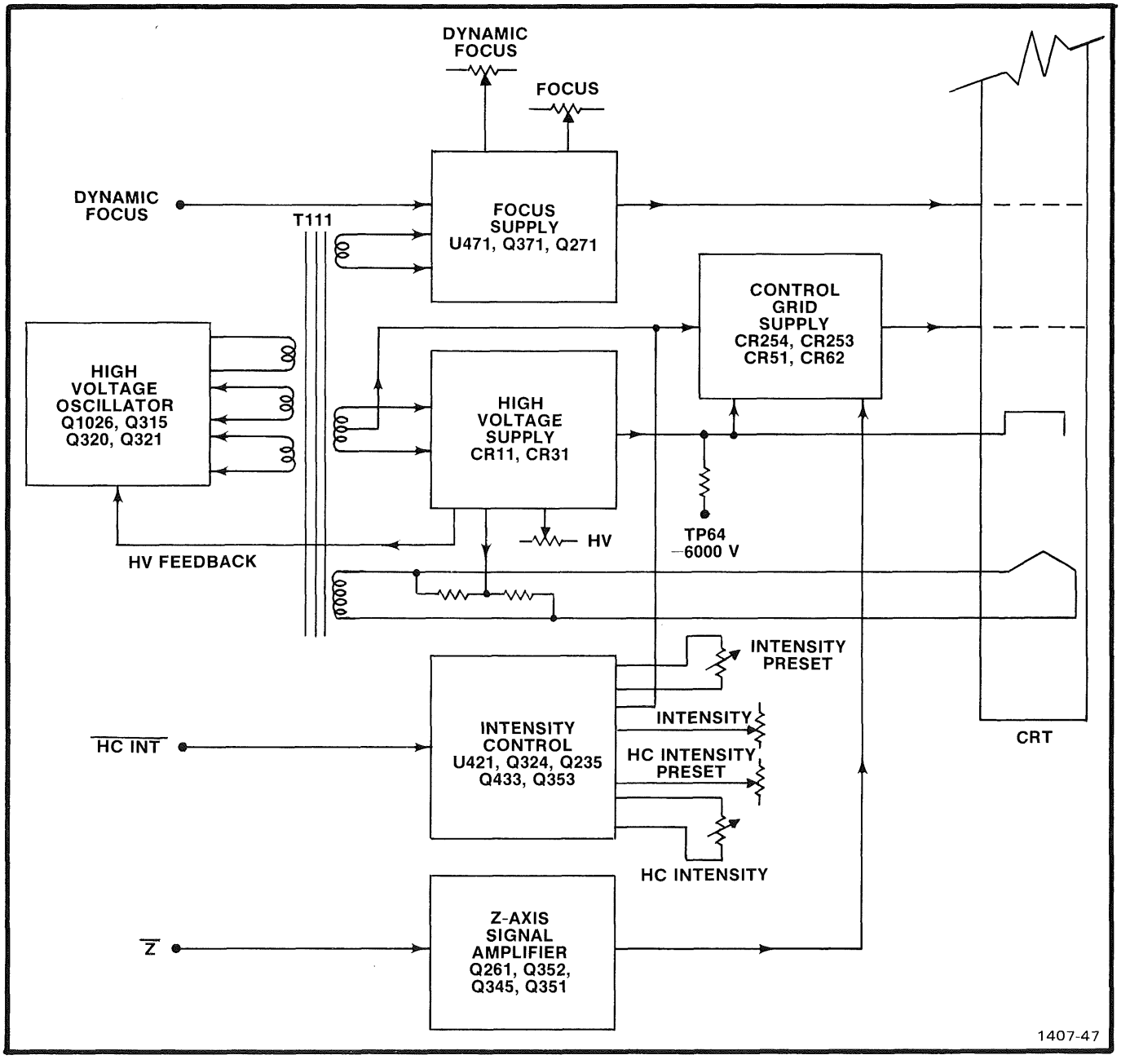


Fig. 4-6. Block diagram of high voltage circuits.

outputs a focus signal to the crt that also compensates for the beam defocusing due to deflections away from the crt center. The Control Grid Supply is controlled by the Z-axis Signal Amplifier to provide Z-axis driving signals to the crt control grid. The Intensity Control controls the writing and hard copy intensities. The Z-axis Signal Amplifier amplifies the $\overline{\text{Z AXIS}}$ signal. The amplifier drives the Control Grid Supply. The Filament Supply is an ac supply for the crt.

Circuit Description

High Voltage Oscillator. Refer to the High Voltage and Z-axis diagram. A blocking oscillator is formed by Q1026 and transformer windings (1, 2) and (3, 4). The bias for switching transistor Q1026 is set by Q315, Q320 and Q321. Q321 receives an ac feedback signal from winding (5, 6) and R233 and a dc bias and a negative feedback signal from R232 in the H V Supply. The bias sets the high voltage. The negative feedback corrects for changes in the high voltage to provide regulation.

High Voltage Supply. Transformer winding (8, 26) and the voltage doubler (which is composed of C13, CR11, CR31 and C132) form the −6000 V cathode supply. R226 sets a bias voltage, via R232, for the H V Oscillator. Voltage divider R141A and R141B supplies the negative feedback signal to the H V Oscillator to maintain the selected voltage.

Focus Supply. The circuit contains an operational amplifier and a voltage doubler. The operational amplifier is composed of U471, Q371 and Q271. The feedback resistor is R475. The DYNAMIC FOCUS input signal (which is a focus correction signal for the beam when it is deflected away from crt center) drives U471 pin 2. The amplifier output signal is from Q271 emitter.

The DYNAMIC FOCUS input signal is 0 V when the beam is at the crt screen center and increases to about 9 V when the beam is deflected to any corner of the screen. The Q271 emitter voltage varies from +20 V (center screen) to +150 V (corner deflection).

The voltage doubler is composed of transformer winding (10, 27), C12, CR12, CR32 and C161. The output voltage is across R161A, R171 and R161B. R161A connects the positive side of the supply to Q271 emitter so that the crt grid output voltage from R171 is referenced to the operational amplifier output signal. The output voltage is about −3000 V for the beam at the screen center.

Control-Grid Supply. The −6000 cathode voltage is applied to C151, via CR51, R53 and R54. Assuming that pin 25 of the transformer is at zero volts, C151 charges to 6000 volts. With signal $\overline{\text{HC INT}}$ high, the voltage at the wiper of R1028 is at approximately +100 V. During one-half cycle of operation, pin 25 of T111 goes positive, with R1028 limiting the bias signal to about +100 V at the R252-CR253 junction. This causes C151 to charge an additional 100 volts, ending up with approximately 6100 volts across it. Assume that $\overline{\text{HC INT}}$ and $\overline{\text{Z AXIS}}$ are both high. The voltage at the top of DS261 is then at approximately +5 volts. When pin 25 of T111 swings negative, CR254 conducts and clamps the bias signal from going below +4.5 V. However, the 95 volt decrease on one side of C151 causes the other side to decrease by an equal amount. As the high voltage side of C151 goes negative to −6100, CR51 becomes back-biased. Since the low-voltage side of C152 is at approximately +5 volts, C152 now charges toward −6100 volts. With C152 charged to −6100 V, the crt grid is placed 95 volts below the cathode voltage, blanking the writing beam.

Intensity Control. The circuit is composed of an operational amplifier and a switch. The operational amplifier is composed of U421, Q324 and Q235. R324 is the feedback resistor. The operational amplifier generates a regulated +250 V at the emitter of Q235. This voltage is required by the intensity cotnrol switch and by the Z-axis Signal Amplifier.

The intensity control switch is composed of Q433 and Q353. During hard copy operation, signal $\overline{\text{HC INT}}$ is low to turn off Q433 and therefore turn on Q353. CR243 and CR251 supply the hard copy bias to the Control Grid Supply. CR242 and CR252 are cut off. During write operation, signal $\overline{\text{HC INT}}$ is high to turn on Q433, CR242 and CR252, and to turn off Q353, CR243 and CR251. Writing INTENSITY control (R1028) and HC INTENSITY control (R1030) are located on the back panel.

Z-axis Signal Amplifier. The circuit is composed of signal amplifier Q261 and Q352 and voltage reference Q345 and Q351.

When $\overline{\text{Z AXIS}}$ is high, Q352 is turned on via bias network R453, R455, R454, R452, R445 and R444. Q352's collector pulls down to about +6 V. Diode CR355 keeps Q352 from saturating for turn-off speed considerations. This is used as a reference voltage for the Control Grid Supply circuit.

When $\overline{\text{Z AXIS}}$ goes low (true) to command the beam to write, Q352 cuts off and its collector voltage rises toward +175 volts. However, the R342-R344 voltage divider holds the base of Q345 at approximately 79 volts. This holds the emitter voltage of Q351 to approximately the same potential. When the collector of Q352 rises to approximately 80 volts, CR351 goes into conduction and holds it at that value. This 80 volts now replaces the +5 volts that had been present at the Q261 emitter.

The change in voltage at the Q261 emitter has an effect on the CRT Control Bias. When the bias signal from T111 via R252 to the C151-CR253 junction drops to approximately 79 volts, CR253 and CR254 go into conduction and hold it at that value rather than permitting it to go to +5 V as before. The negative voltage swing at the CR253-C151 junction is therefore limited to +79 volts. The low-voltage level follows suit. The writing voltage decreases the voltage difference between grid and cathode to approximately 30 volts, permitting information to be written on the crt. L361 is used for inductive peaking of the unblanking circuit.

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.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

ITEM NAME

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

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
01121	Allen-Bradley Co.	1201 2nd St. South	Milwaukee, WI 53204
01295	Texas Instruments, Inc., Semiconductor Group	P. O. Box 5012	Dallas, TX 75222
02735	RCA Corp., Solid State Division	Route 202	Somerville, NY 08876
03877	Transitron Electronic Corp.	168 Albion St.	Wakefield, MA 01880
04713	Motorola, Inc., Semiconductor Products Div.	5005 E. McDowell Rd.	Phoenix, AZ 85036
06288	Edal Industries, Inc.	4 Short Beach Road	East Haven, CT 06512
07263	Fairchild Semiconductor, A Div. of Fairchild Camera and Instrument Corp.	464 Ellis St.	Mountain View, CA 94042
07910	Teledyne Semiconductor	12515 Chadron Ave.	Hawthorne, CA 90250
08806	General Electric Co., Miniature Lamp Products Dept.	Nela Pk.	Cleveland, OH 44112
12040	National Semiconductor Corp.	Commerce Drive	Danbury, CT 06810
12697	Clarostat Mfg. Co., Inc.	Lower Washington St.	Dover, NH 03820
12969	Unitrode Corp.	580 Pleasant St.	Watertown, MA 02172
14099	Semtech Corp.	652 Mitchell Road	Newbury Park, CA 91320
14193	Cal-R, Inc.	1601 Olympic Blvd.	Santa Monica, CA 90404
15818	Teledyne Semiconductor	1300 Terra Bella Ave.	Mountain View, CA 94040
16758	Delco Electronics, Div. of General Motors Corp.	700 E. Firmin St.	Kokomo, IN 46901
21845	Solitron Devices, Inc., Transistor Div.	1177 Blue Heron Blvd.	Riviera Beach, FL 33404
27014	National Semi-Conductor Corp.	2900 San Ysidro Way	Santa Clara, CA 95051
27193	Cutler-Hammer, Inc. Specialty Products Division	4201 N. 27th St.	Milwaukee, WI 53216
28480	Hewlett-Packard Co., Corporate Hq.	1501 Page Mill Rd.	Palo Alto, CA 94304
32293	Intersil, Inc.	10900 N. Tantau Ave.	Cupertino, CA 95014
56289	Sprague Electric Co.		North Adams, MA 01247
71400	Bussman Mfg., Division of McGraw-Edison Co.	2536 W. University St.	St. Louis, MO 63107
71450	CTS Corp.	1142 W. Beardsley Ave.	Elkhart, IN 46514
71468	ITT Cannon Electric	666 E. Dyer Rd.	Santa Ana, CA 92702
71590	Centralab Electronics, Div. of Globe-Union, Inc.	5757 N. Green Bay Ave.	Milwaukee, WI 53201
71785	TRW Electronic Components, Cinch Connector Operations	1501 Morse Ave.	Elk Grove Village, IL 60007
72982	Erie Technological Products, Inc.	644 W. 12th St.	Erie, PA 16512
75042	TRW Electronic Components, IRC Fixed Resistors, Philadelphia Division	401 N. Broad St.	Philadelphia, PA 19108
76493	Bell Industries, Inc., Miller, J. W., Div.	19070 Reyes Ave.	Compton, CA 90224
80009	Tektronix, Inc.	P. O. Box 500	Beaverton, OR 97077
80294	Bourns, Inc., Instrument Div.	6135 Magnolia Ave.	Riverside, CA 92506
81439	Therm-O-Disc, Inc.	1320 S. Main St.	Mansfield, OH 44907
81483	International Rectifier Corp.	9220 Sunset Blvd.	Los Angeles, CA 90069
83003	Varo, Inc.	800 W. Garland Ave.	Garland, TX 75040
90201	Mallory Capacitor Co., Div. of P. R. Mallory Co., Inc.	3029 E. Washington St.	Indianapolis, IN 46206
91637	Dale Electronics, Inc.	P. O. Box 609	Columbus, NB 68601
91836	Kings Electronics Co., Inc.	40 Marbledale Road	Tuckahoe, NY 10707
95712	Bendix Corp., The Electrical Components Div., Microwave Devices Plant	Hurricane Road	Franklin, IN 46131

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				CHASSIS		
CR1004	152-0414-00			SEMICOND DEVICE:200V,0.75A	80009	152-0414-00
CR1008	152-0414-00			SEMICOND DEVICE:200V,0.75A	80009	152-0414-00
CR1015A CR1015B CR1015C CR1015D	152-0406-00			SEMICOND DEVICE:SILICON,200V,3A	83003	W601
CR1018	150-1001-00			LAMP,LED:RED,2V,100MA	28480	5082-4403
F1014	159-0015-00			FUSE,CARTRIDGE:3AG,3A,250V,FAST-BLOW	71400	AGC3
J701	131-0569-00			CONNECTOR,RCPT,:25 PIN,FEMALE	71468	DB25S
J705	131-0458-00			CONNECTOR,RCPT,:15 PIN,FEMALE	71468	DA15S
J1001	131-0274-00			CONNECTOR,RCPT,:BNC	91836	KC79-67
J1002	131-0274-00			CONNECTOR,RCPT,:BNC	91836	KC79-67
J1003	131-0126-00			CONNECTOR,RCPT,:BNC,FEMALE	95712	9663-INT34
L1001A,B	119-0395-00			COIL,TUBE DFL:	80009	119-0395-00
Q1002	151-0349-00	B010100	B059999	TRANSISTOR:SILICON,NPN SEL FROM MJE2801	80009	151-0349-00
Q1002	151-0349-02	B060000		TRANSISTOR:SILICON,NPN	80009	151-0349-02
Q1004	151-0373-00	B010100	B059999	TRANSISTOR:SILICON,PNP	04713	SJE925
Q1004	151-0373-01	B060000		TRANSISTOR:SILICON,PNP	80009	151-0373-01
Q1006	151-0349-00	B010100	B059999	TRANSISTOR:SILICON,NPN SEL FROM MJE2801	80009	151-0349-00
Q1006	151-0349-02	B060000		TRANSISTOR:SILICON,NPN	80009	151-0349-02
Q1008	151-0373-00	B010100	B059999	TRANSISTOR:SILICON,PNP	04713	SJE925
Q1008	151-0373-01	B060000		TRANSISTOR:SILICON,PNP	80009	151-0373-01
Q1010	151-0358-00			TRANSISTOR:SILICON,NPN,SEL FROM D44R4	80009	151-0358-00
Q1012	151-0358-00			TRANSISTOR:SILICON,NPN,SEL FROM D44R4	80009	151-0358-00
Q1016	151-0337-00			TRANSISTOR:SILICON,NPN	21845	93SX287
Q1020	151-0337-00			TRANSISTOR:SILICON,NPN	21845	93SX287
Q1022	151-0337-00			TRANSISTOR:SILICON,NPN	21845	93SX287
Q1026	151-0256-00			TRANSISTOR:SILICON,NPN	16758	7305762
R1010	311-0546-00			RES.,VAR,NONWIR:10K OHM,20%,0.75W	01121	W-8154
R1012	315-0102-03			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R1028	311-0164-00			RES.,VAR,NONWIR:PNL,50K OHM,0.5W	01121	WA1G032S501UA
R1030	311-0642-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	12697	382-CM39820
S1014	260-1102-00	B010100	B070579	SWITCH,TOGGLE:DPST,15A,125VAC	27193	8906K-1667
S1014	260-1060-01	B070580		SWITCH,LEVER:DPST,15A,125VAC,60HZ	27193	8906K1640
S1015	260-0551-00			SWITCH,THRMSTC:SPSTNC,10A,250V	81439	S636336T21
T1015	120-0825-00			XFMR,PWR,SDN/SU:	80009	120-0825-00
U1018	156-0176-00			MICROCIRCUIT,LI:5V REGULATOR	12040	LM309K
V1	154-0663-11			ELECTRON TUBE:11 INCH DIAMETER	80009	154-0663-11
A1	670-2303-00	B010100	B049999	CKT BOARD ASSY:DEFLECTION AMPL	80009	670-2303-00
A1A	670-2955-00	XB020000	B049999X	CKT BOARD ASSY:ORIGIN SHIFTER	80009	670-2955-00
A1	670-2303-01	B050000	B069999	CKT BOARD ASSY:DEFLECTION AMPL	80009	670-2303-01
A1	670-2303-02	B070000	B079999	CKT BOARD ASSY:DEFLECTION AMPL	80009	670-2303-02
A1	670-2303-03	B080000		CKT BOARD ASSY:DEFLECTION AMPL	80009	670-2303-03

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C1	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C11	283-0111-00	B010100	B079999	CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131N075651104M
C11	283-0010-00	B080000		CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C15	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C16	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C19	290-0529-00			CAP.,FXD,ELCTLT:47UF,20%,20V	56289	196D476X0020LA3
C33	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C45	283-0177-00	XB080000		CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C80	283-0047-00	XB020000	B049999X	CAP.,FXD,CER DI:270PF,5%,500V	72982	861-518B271J
C106	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	72982	301-000X5P0121K
C114	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	72982	301-000X5P0121K
C117	281-0622-00			CAP.,FXD,CER DI:47PF,1%,500V	72982	308-000C0G0470F
C130	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C147	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C148	283-0177-00	XB080000		CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C179	283-0002-00	XB020000		CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C201	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C202	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C211	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	72982	301-000X5P0121K
C213	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	72982	301-000X5P0121K
C219	281-0622-00			CAP.,FXD,CER DI:47PF,1%,500V	72982	308-000C0G0470F
C220	281-0622-00			CAP.,FXD,CER DI:47PF,1%,500V	72982	308-000C0G0470F
C232	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C242	283-0001-00			CAP.,FXD,CER DI:0.005UF,+100-0%,500V	72982	831-559E502P
C251	283-0028-00			CAP.,FXD,CER DI:0.0022UF,20%,50V	56289	19C606
C252	283-0028-00			CAP.,FXD,CER DI:0.0022UF,20%,50V	56289	19C606
C253	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	72982	301-000X5P0121K
C273	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131N075651104M
C311	283-0111-00	B010100	B079999	CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131N075651104M
C311	283-0010-00	B080000		CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C312	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C313	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C331	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C332	290-0512-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C334	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C341	281-0622-00			CAP.,FXD,CER DI:47PF,1%,500V	72982	308-000C0G0470F
C342	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C351	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006FL
C354	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C371	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C405	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C424	283-0065-00			CAP.,FXD,CER DI:0.001UF,5%,100V	72982	805-505B102J
C431	290-0535-00			CAP.,FXD,ELCTLT:33UF,20%,10V	56289	196D336X0010KA1
C475	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,350V	72982	301-000U2M0101M
C521	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C531	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C552	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C561	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C562	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C565	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C572	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0025HA1
C574	281-0622-00			CAP.,FXD,CER DI:47PF,1%,500V	72982	308-000C0G0470F
C575	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0025HA1

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C578	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-000C0G0100F
C579	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0025HA1
CR2	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR3	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR15	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR16	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR17	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR32	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR33	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR72	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR77	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR78	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR114	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR115	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR132	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR133	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR143	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR144	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR175	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR176	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR213	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR214	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR217	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR232	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR233	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR252	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR262	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR263	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR271	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR272	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR273	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR303	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR304	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR354	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR431	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR472	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR501	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR502	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR503	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR504	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR505	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR506	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR507	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR577	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
F101	159-0114-00	B010100	B059999	FUSE,CARTRIDGE:1A,125VAC,FAST-BLOW	71400	GFA1
F101	159-0022-00	B060000		FUSE,CARTRIDGE:3AG,1A,250V,FAST-BLOW	71400	AGC1
F102	159-0114-00	B010100	B059999	FUSE,CARTRIDGE:1A,125VAC,FAST-BLOW	71400	GFA1
F102	159-0022-00	B060000		FUSE,CARTRIDGE:3AG,1A,250V,FAST-BLOW	71400	AGC1
Q5	151-0136-00			TRANSISTOR:SILICON,NPN	02735	35495
Q6	151-0235-00			TRANSISTOR:SILICON,PNP	04713	2N4890
Q16	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q25A,B	151-0354-00			TRANSISTOR:SILICON,PNP,DUAL	32293	ITS1200A

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q26A,B	151-0354-00			TRANSISTOR:SILICON,PNP,DUAL	32293	ITS1200A
Q125A,B	151-0354-00			TRANSISTOR:SILICON,PNP,DUAL	32293	ITS1200A
Q221A,B	151-0354-00			TRANSISTOR:SILICON,PNP,DUAL	32293	ITS1200A
Q271	151-0188-00			TRANSISTOR:SILICON,PNP	04713	2N3906
Q302	151-0136-00			TRANSISTOR:SILICON,NPN	02735	35495
Q311	151-0235-00			TRANSISTOR:SILICON,PNP	04713	2N4890
Q403	151-0188-00			TRANSISTOR:SILICON,PNP	04713	2N3906
Q451	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q476	151-0192-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS6521	80009	151-0192-00
Q572	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
R2	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R11	315-0101-00	B010100	B079999	RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R11	315-0330-01	B080000		RES.,FXD,COMP:33 OHM,5%,0.25W	01121	CB3305
R13	315-0222-00			RES.,FXD,COMP:2.2K OHM,5%,0.25W	01121	CB2225
R14	321-0287-00			RES.,FXD,FILM:9.53K OHM,1%,0.125W	75042	CEAT0-9531F
R15	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R16	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R17	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R18	315-0222-00			RES.,FXD,COMP:2.2K OHM,5%,0.25W	01121	CB2225
R19	315-0753-00			RES.,FXD,COMP:75K OHM,5%,0.25W	01121	CB7535
R20	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R21	321-0304-00			RES.,FXD,FILM:14.3K OHM,1%,0.125W	75042	CEAT0-1432F
R30	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R31	315-0753-00			RES.,FXD,COMP:75K OHM,5%,0.25W	01121	CB7535
R40	321-0614-00			RES.,FXD,FILM:10.1K OHM,1%,0125W	75042	CEAT0-1012F
R41	321-0368-00			RES.,FXD,FILM:66.5K OHM,1%,0.125W	75042	CEAT0-6652F
R42	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R43	315-0470-00			RES.,FXD,COMP:47 OHM,5%,0.25W	01121	CB4705
R44	315-0753-00			RES.,FXD,COMP:75K OHM,5%,0.25W	01121	CB7535
R45	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	80294	3389F-P31-104
R46	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	80294	3389F-P31-104
R47	311-1230-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	80294	3389F-P31-203
R48	311-1227-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	80294	3389F-P31-502
R49	311-1227-00			RES.,VAR,NONWIR:5K OHM,20%,0.50W	80294	3389F-P31-502
R50	311-1230-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	80294	3389F-P31-203
R51	321-0398-00			RES.,FXD,FILM:137K OHM,1%,0.125W	75042	CEAT0-1373F
R52	322-0469-00			RES.,FXD,FILM:750K OHM,1%,0.25W	75042	CEBT0-7503F
R53	321-0282-00			RES.,FXD,FILM:8.45K OHM,1%,0.125W	75042	CEAT0-8451F
R54	321-0380-00			RES.,FXD,FILM:88.7K OHM,1%,0.125W	75042	CEAT0-8872F
R55	321-0302-00			RES.,FXD,FILM:13.7K OHM,1%,0.125W	75042	CEAT0-1372F
R56	321-0302-00			RES.,FXD,FILM:13.7K OHM,1%,0.125W	75042	CEAT0-1372F
R57	321-0293-00			RES.,FXD,FILM:11K OHM,1%,0.125W	75042	CEAT0-1102F
R58	321-0302-00			RES.,FXD,FILM:13.7K OHM,1%,0.125W	75042	CEAT0-1372F
R59	321-0302-00			RES.,FXD,FILM:13.7K OHM,1%,0.125W	75042	CEAT0-1372F
R60	321-0618-00			RES.,FXD,FILM:250K OHM,1%,0.125W	75042	CEAT0-2503F
R61	321-0398-00			RES.,FXD,FILM:137K OHM,1%,0.125W	75042	CEAT0-1373F
R62	321-0213-00			RES.,FXD,FILM:1.62K OHM,1%,0.125W	75042	CEAT0-1621F
R63	321-0380-00			RES.,FXD,FILM:88.7K OHM,1%,0.125W	75042	CEAT0-8872F
R64	321-0284-00			RES.,FXD,FILM:8.87K OHM,1%,0.125W	75042	CEAT0-8871F
R65	321-0201-00			RES.,FXD,FILM:1.21K OHM,1%,0.125W	75042	CEAT0-1211F
R66	321-0293-00			RES.,FXD,FILM:11K OHM,1%,0.125W	75042	CEAT0-1102F
R67	321-0302-00			RES.,FXD,FILM:13.7K OHM,1%,0.125W	75042	CEAT0-1372F
R68	321-0274-00			RES.,FXD,FILM:6.98K OHM,1%,0.125W	75042	CEAT0-6981F

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R69	321-0302-00			RES.,FXD,FILM:13.7K OHM,1%,0.125W	75042	CEAT0-1372F
R70	321-0302-00			RES.,FXD,FILM:13.7K OHM,1%,0.125W	75042	CEAT0-1372F
R71	321-0302-00			RES.,FXD,FILM:13.7K OHM,1%,0.125W	75042	CEAT0-1372F
R72	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R73	321-0347-00			RES.,FXD,FILM:40.2K OHM,1%,0.125W	75042	CEAT0-4022F
R74	321-0347-00			RES.,FXD,FILM:40.2K OHM,1%,0.125W	75042	CEAT0-4022F
R75	321-0347-00			RES.,FXD,FILM:40.2K OHM,1%,0.125W	75042	CEAT0-4022F
R76	321-0347-00			RES.,FXD,FILM:40.2K OHM,1%,0.125W	75042	CEAT0-4022F
R77	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R78	315-0512-00			RES.,FXD,COMP:5.1K OHM,5%,0.25W	01121	CB5125
R79	315-0102-00	XB020000		RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R80	315-0101-00	XB020000	B049999X	RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R101	303-0391-00			RES.,FXD,COMP:390 OHM,5%,1W	01121	GB3915
R102	303-0391-00			RES.,FXD,COMP:390 OHM,5%,1W	01121	GB3915
R103	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R104A R104B R104C R104D R104E R104F R104G R104H	307-0344-00			RES.,FXD,FILM:8 SECTION,1.5 OHM EA SECT	80009	307-0344-00
R105	315-0201-00			RES.,FXD,COMP:200 OHM,5%,0.25W	01121	CB2015
R106	321-0271-00			RES.,FXD,FILM:6.49K OHM,1%,0.125W	75042	CEAT0-6491F
R111	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R112	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	75042	CEAT0-1004F
R113	315-0204-00			RES.,FXD,COMP:200K OHM,5%,0.25W	01121	CB2045
R114	321-0271-00			RES.,FXD,FILM:6.49K OHM,1%,0.125W	75042	CEAT0-6491F
R115	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R116	321-0304-00			RES.,FXD,FILM:14.3K OHM,1%,0.125W	75042	CEAT0-1432F
R117	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R119	321-0193-00			RES.,FXD,FILM:1K OHM,1%,0.125W	75042	CEAT0-1001F
R120	315-0470-00			RES.,FXD,COMP:47 OHM,5%,0.25W	01121	CB4705
R132	315-0753-00			RES.,FXD,COMP:75K OHM,5%,0.25W	01121	CB7535
R134	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	75042	CEAT0-1003F
R135	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R141	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R142	321-0373-00			RES.,FXD,FILM:75K OHM, 1%,0.125W	75042	CEAT0-7502F
R171	321-0282-00			RES.,FXD,FILM:8.45K OHM,1%,0.125W	75042	CEAT0-8451F
R172	321-0282-00			RES.,FXD,FILM:8.45K OHM,1%,0.125W	75042	CEAT0-8451F
R173	321-0282-00			RES.,FXD,FILM:8.45K OHM,1%,0.125W	75042	CEAT0-8451F
R174	321-0282-00			RES.,FXD,FILM:8.45K OHM,1%,0.125W	75042	CEAT0-8451F
R175	321-0288-00			RES.,FXD,FILM:9.76K OHM,1%,0.125W	75042	CEAT0-9761F
R176	315-0123-00			RES.,FXD,COMP:12K OHM,5%,0.25W	01121	CB1235
R201	308-0244-00			RES.,FXD,WW:0.3 OHM,10%,2W	91637	RS2B162ER3000K
R202	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R203	315-0201-00			RES.,FXD,COMP:200 OHM,5%,0.25W	01121	CB2015
R204	315-0204-00			RES.,FXD,COMP:200K OHM,5%,0.25W	01121	CB2045
R205	321-0481-00			RES.,FXD,FILM:1M OHM,1%,0.125W	75042	CEAT0-1004F
R211	321-0271-00			RES.,FXD,FILM:6.49K OHM,1%,0.125W	75042	CEAT0-6491F
R212	321-0271-00			RES.,FXD,FILM:6.49K OHM,1%,0.125W	75042	CEAT0-6491F
R213	321-0287-00			RES.,FXD,FILM:9.53K OHM,1%,0.125W	75042	CEAT0-9531F

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R214	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R217	315-0470-00			RES.,FXD,COMP:47 OHM,5%,0.25W	01121	CB4705
R218	321-0205-00			RES.,FXD,FILM:1.33K OHM,1%,0.125W	75042	CEAT0-1331F
R219	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R220	321-0304-00			RES.,FXD,FILM:14.3K OHM,1%,0.125W	75042	CEAT0-1432F
R221	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R222	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	75042	CEAT0-7501F
R223	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R224	321-0277-00			RES.,FXD,FILM:7.5K OHM,1%,0.125W	75042	CEAT0-7501F
R225	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R231	315-0470-00			RES.,FXD,COMP:47 OHM,5%,0.25W	01121	CB4705
R232	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R234	321-0614-00			RES.,FXD,FILM:10.1K OHM,1%,0125W	75042	CEAT0-1012F
R235	321-0381-00			RES.,FXD,FILM:90.9K OHM,1%,0.125W	75042	CEAT0-9092F
R240	311-1230-00			RES.,VAR,NONWIR:20K OHM,20%,0.50W	80294	3389F-P31-203
R243	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	75042	CEAT0-2002F
R246	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R247	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R248	321-0447-00			RES.,FXD,FILM:442K OHM,1%,0.125W	75042	CEAT0-4423F
R250	315-0512-00			RES.,FXD,COMP:5.1K OHM,5%,0.25W	01121	CB5125
R251	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	75042	CEAT0-1003F
R252	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R253	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R254	321-0251-00			RES.,FXD,FILM:4.02K OHM,1%,0.125W	75042	CEAT0-4021F
R255	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R256	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R257	315-0473-00	XB020000		RES.,FXD,COMP:47K OHM,5%,0.25W	01121	CB4735
R261	321-0385-00			RES.,FXD,FILM:100K OHM,1%,0.125W	75042	CEAT0-1003F
R262	315-0512-00			RES.,FXD,COMP:5.1K OHM,5%,0.25W	01121	CB5125
R263	321-0280-00			RES.,FXD,FILM:8.06K OHM,1%,0.125W	75042	CEAT0-8061F
R301	311-1222-00			RES.,VAR,NONWIR:100 OHM,20%,0.50W	80294	3389F-P31-101
R302	311-1222-00			RES.,VAR,NONWIR:100 OHM,20%,0.50W	80294	3389F-P31-101
R304	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	80294	3389F-P31-103
R310	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R311	315-0101-00	B010100	B079999	RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R311	315-0330-01	B080000		RES.,FXD,COMP:33 OHM,5%,0.25W	01121	CB3305
R313	315-0222-00			RES.,FXD,COMP:2.2K OHM,5%,0.25W	01121	CB2225
R320	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R321	321-0304-00			RES.,FXD,FILM:14.3K OHM,1%,0.125W	75042	CEAT0-1432F
R322	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R323	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R324	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R332	315-0333-00			RES.,FXD,COMP:33K OHM,5%,0.25W	01121	CB3335
R334	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R335	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R341	321-0258-00			RES.,FXD,FILM:4.75K OHM,1%,0.125W	75042	CEAT0-4751F
R349	315-0273-00			RES.,FXD,COMP:27K OHM,5%,0.25W	01121	CB2735
R350	315-0473-00	XB020000		RES.,FXD,COMP:47K OHM,5%,0.25W	01121	CB4735
R351	301-0475-00			RES.,FXD,COMP:4.7M OHM,5%,0.50W	01121	EB4755
R352	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R353	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R361	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R366	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R372	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R373	315-0303-00			RES.,FXD,COMP:30K OHM,5%,0.25W	01121	CB3035
R374	315-0303-00			RES.,FXD,COMP:30K OHM,5%,0.25W	01121	CB3035
R375	315-0201-00			RES.,FXD,COMP:200 OHM,5%,0.25W	01121	CB2015
R376	321-0251-00	XB020000		RES.,FXD,FILM:4.02K OHM,1%,0.125W	75042	CEAT0-4021F
R377	321-0355-00	XB020000		RES.,FXD,FILM:48.7K OHM,1%,0.125W	75042	CEAT0-4872F
R378	321-0289-00	XB020000		RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R379	321-0289-00	XB020000		RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R380	321-0289-00	XB020000		RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R381	321-0316-00	XB020000		RES.,FXD,FILM:19.1K OHM,1%,0.125W	75042	CEAT0-1912F
R382	321-0193-00	XB020000		RES.,FXD,FILM:1K OHM,1%,0.125W	75042	CEAT0-1001F
R401	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	X201R104B
R402	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	X201R104B
R403	301-0272-00			RES.,FXD,COMP:2.7K OHM,5%,0.50W	01121	EB2725
R404	315-0203-00			RES.,FXD,COMP:20K OHM,5%,0.25W	01121	CB2035
R405	315-0202-00			RES.,FXD,COMP:2K OHM,5%,0.25W	01121	CB2025
R406	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R407	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R408	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R409	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	80294	3389F-P31-103
R411	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R412	315-0512-00			RES.,FXD,COMP:5.1K OHM,5%,0.25W	01121	CB5125
R413	315-0512-00			RES.,FXD,COMP:5.1K OHM,5%,0.25W	01121	CB5125
R417	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R421	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R422	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R423	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R424	315-0333-00			RES.,FXD,COMP:33K OHM,5%,0.25W	01121	CB3335
R431	315-0433-00			RES.,FXD,COMP:43K OHM,5%,0.25W	01121	CB4335
R442	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R451	321-0429-00			RES.,FXD,FILM:287K OHM,1%,0.125W	75042	CEAT0-2873F
R452	321-0429-00			RES.,FXD,FILM:287K OHM,1%,0.125W	75042	CEAT0-2873F
R453	315-0824-00			RES.,FXD,COMP:820K OHM,5%,0.25W	01121	CB8245
R454	315-0182-00			RES.,FXD,COMP:1.8K OHM,5%,0.25W	01121	CB1825
R455	315-0392-00			RES.,FXD,COMP:3.9K OHM,5%,0.25W	01121	CB3925
R456	321-0444-00			RES.,FXD,FILM:412K OHM,1%,0.125W	75042	CEAT0-4123F
R462	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R463	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R471	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R472	315-0181-00			RES.,FXD,COMP:180 OHM,5%,0.25W	01121	CB1815
R473	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R474	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R475	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R476	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R501	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	X201R104B
R502	311-1136-00			RES.,VAR,NONWIR:100K OHM,30%,0.25W	71450	X201R104B
R504	315-0512-00			RES.,FXD,COMP:5.1K OHM,5%,0.25W	01121	CB5125
R505	315-0512-00			RES.,FXD,COMP:5.1K OHM,5%,0.25W	01121	CB5125
R509	315-0473-00			RES.,FXD,COMP:47K OHM,5%,0.25W	01121	CB4735
R512	315-0153-00			RES.,FXD,COMP:15K OHM,5%,0.25W	01121	CB1535
R521	315-0105-00			RES.,FXD,COMP:1M OHM,5%,0.25W	01121	CB1055
R522	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R523	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R531	315-0153-00			RES.,FXD,COMP:15K OHM,5%,0.25W	01121	CB1535
R541	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R543	315-0681-00			RES.,FXD,COMP:680 OHM,5%,0.25W	01121	CB6815
R552	315-0824-00			RES.,FXD,COMP:820K OHM,5%,0.25W	01121	CB8245
R554	321-0444-00			RES.,FXD,FILM:412K OHM,1%,0.125W	75042	CEAT0-4123F
R555	321-0415-00			RES.,FXD,FILM:205K OHM,1%	75042	CEAT0-2053F
R556	321-0415-00			RES.,FXD,FILM:205K OHM,1%	75042	CEAT0-2053F
R557	321-0447-00			RES.,FXD,FILM:442K OHM,1%,0.125W	75042	CEAT0-4423F
R563	307-0103-00			RES.,FXD,COMP:2.7 OHM,5%,0.25W	01121	CB27G5
R564	307-0103-00			RES.,FXD,COMP:2.7 OHM,5%,0.25W	01121	CB27G5
R571	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R572	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R573	321-0233-00			RES.,FXD,FILM:2.61K OHM,1%,0.125W	75042	CEAT0-2611F
R574	315-0220-00			RES.,FXD,COMP:22 OHM,5%,0.25W	01121	CB2205
R575	321-0223-00			RES.,FXD,FILM:2.05K OHM,1%,0.125W	75042	CEAT0-2051F
R576	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	75042	CEAT0-3011F
R577	315-0121-00			RES.,FXD,COMP:120 OHM,5%,0.25W	01121	CB1215
R578	315-0181-00			RES.,FXD,COMP:180 OHM,5%,0.25W	01121	CB1815
R579	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
U79	156-0032-00			MICROCIRCUIT,DI:4-BIT BINARY COUNTER	01295	SN7493AN
U115	156-0067-03			MICROCIRCUIT,LI:OPERATIONAL AMPL	12040	LM741CN
U124	155-0035-00			MICROCIRCUIT,LI:QUAD OPERATIONAL AMPL	80009	155-0035-00
U136	155-0035-00			MICROCIRCUIT,LI:QUAD OPERATIONAL AMPL	80009	155-0035-00
U151	156-0067-03			MICROCIRCUIT,LI:OPERATIONAL AMPL	12040	LM741CN
U152	156-0067-03			MICROCIRCUIT,LI:OPERATIONAL AMPL	12040	LM741CN
U161	156-0067-03			MICROCIRCUIT,LI:OPERATIONAL AMPL	12040	LM741CN
U162	156-0067-03			MICROCIRCUIT,LI:OPERATIONAL AMPL	12040	LM741CN
U179	156-0093-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7416N
U215	156-0067-03			MICROCIRCUIT,LI:OPERATIONAL AMPL	12040	LM741CN
U315	156-0067-03			MICROCIRCUIT,LI:OPERATIONAL AMPL	12040	LM741CN
U324	156-0072-00			MICROCIRCUIT,DI:MONOSTABLE MV,TTL	12040	DM74121N
U342	156-0172-00			MICROCIRCUIT,DI:DUAL MONOSTABLE MV	01295	SN74123N
U343	156-0092-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7405N
U353	156-0172-00			MICROCIRCUIT,DI:DUAL MONOSTABLE MV	01295	SN74123N
U361	156-0145-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND BFR	01295	SN7438N
U371	156-0093-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7416N
U415	156-0067-03			MICROCIRCUIT,LI:OPERATIONAL AMPL	12040	LM741CN
U424	156-0172-00			MICROCIRCUIT,DI:DUAL MONOSTABLE MV	01295	SN74123N
U432	156-0093-00			MICROCIRCUIT,DI:HEX.INVERTER	01295	SN7416N
U443	156-0034-00			MICROCIRCUIT,DI:DUAL 4-INPUT NAND GATE	01295	SN7420N
U444	156-0032-00			MICROCIRCUIT,DI:4-BIT BINARY COUNTER	01295	SN7493AN
U471	156-0030-00			MICROCIRCUIT,DI:QUAD 2-INPUT POS NAND GATE	01295	SN7400N
U515	156-0067-03			MICROCIRCUIT,LI:OPERATIONAL AMPL	12040	LM741CN
U524	156-0072-00			MICROCIRCUIT,DI:MONOSTABLE MV,TTL	12040	DM74121N
U532	156-0094-00			MICROCIRCUIT,DI:DUAL PERIPHERAL DRIVER	01295	SN75451P
U545	156-0032-00			MICROCIRCUIT,DI:4-BIT BINARY COUNTER	01295	SN7493AN
U553	156-0058-00			MICROCIRCUIT,DI:HEX INVERTER	04713	MC7404P
U571	156-0149-00			MICROCIRCUIT,DI:DUAL 4-INPUT ST	01295	SN7413N
VR15	152-0304-00			SEMICOND DEVICE:ZENER,0.4W,20V,5%	04713	1N968B
VR311	152-0304-00			SEMICOND DEVICE:ZENER,0.4W,20V,5%	04713	1N968B
VR512	152-0395-00			SEMICOND DEVICE:ZENER,0.4W,4.3V,5%	07910	1N749A

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				CKT BOARD ASSY:SWITCH	80009	670-2305-00
A2	670-2305-00					
S1008	260-1308-00			SWITCH,PUSH:MOMENTARY	71590	2KAA010000-440
S1010	260-1308-00			SWITCH,PUSH:MOMENTARY	71590	2KAA010000-440
VR21	152-0299-00			SEMICOND DEVICE:ZENER,1.5W,5%,200V	04713	1N38206
VR121	152-0299-00			SEMICOND DEVICE:ZENER,1.5W,5%,200V	04713	1N38206
VR132	152-0510-01			SEMICOND DEVICE:ZENER,1W,5%,150V	04713	1M150ZS5
VR231	152-0150-00			SEMICOND DEVICE:ZENER,0.75W,5%,51V	04713	1N3037B
A3	670-2306-00	B010100	B039999	CKT BOARD ASSY:HARD COPY AMPLIFIER	80009	670-2306-00
A3	670-2306-01	B040000	B069999	CKT BOARD ASSY:HARD COPY AMPLIFIER	80009	670-2306-01
A3	670-2306-02	B070000		CKT BOARD ASSY:HARD COPY AMPLIFIER	80009	670-2306-02
C32	281-0623-00			CAP.,FXD,CER DI:650PF,5%,500V	72982	301-000Y5D0651J
C34	281-0623-00			CAP.,FXD,CER DI:650PF,5%,500V	72982	301-000Y5D0651J
C35	281-0512-00			CAP.,FXD,CER DI:27PF,+/-2.7PF,500V	72982	308-000C0G0270K
C41	281-0623-00			CAP.,FXD,CER DI:650PF,5%,500V	72982	301-000Y5D0651J
C51	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131N075651104M
C111	283-0008-01			CAP.,FXD,CER DI:0.1UF,500V	80009	283-0008-01
C112	283-0008-01			CAP.,FXD,CER DI:0.1UF,500V	80009	283-0008-01
C142	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C143	281-0623-00			CAP.,FXD,CER DI:650PF,5%,500V	72982	301-000Y5D0651J
C150	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131N075651104M
C231	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C240	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131N075651104M
C241	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C245	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131N075651104M
C250	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,350V	72982	301-000U2M0101M
C251	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
CR102	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR103	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
J20	136-0058-00			SKT,PL-IN ELEK:7 CONTACT	71785	111-51-11-014
L21	108-0146-00			COIL,RF:5UH	80009	108-0146-00
Q240	151-0134-00			TRANSISTOR:SILICON,PNP	04713	2N2905A
R21	315-0681-00			RES.,FXD,COMP:680 OHM,5%,0.25W	01121	CB6815
R32	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R33	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R40	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R51	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R101	301-0101-00			RES.,FXD,COMP:100 OHM,5%,0.50W	01121	EB1015
R113	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R114	303-0680-00			RES.,FXD,COMP:68 OHM,5%,1W	01121	GB6805
R115	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R133	315-0753-00			RES.,FXD,COMP:75K OHM,5%,0.25W	01121	CB7535
R134	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	80294	3389F-P31-104
R135	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R136	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R137	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	80294	3389F-P31-103
R141	315-0153-00			RES.,FXD,COMP:15K OHM,5%,0.25W	01121	CB1535
R142	315-0432-00			RES.,FXD,COMP:4.3K OHM,5%,0.25W	01121	CB4325
R143	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R150	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R230	307-0103-00			RES.,FXD,COMP:2.7 OHM,5%,0.25W	01121	CB27G5
R233	321-0214-00			RES.,FXD,FILM:1.65K OHM,1%,0.125W	75042	CEAT0-1651F
R240	301-0151-00			RES.,FXD,COMP:150 OHM,5%,0.50W	01121	EB1515
R241	321-0231-00			RES.,FXD,FILM:2.49K OHM,1%,0.125W	75042	CEAT0-2491F
R245	307-0103-00			RES.,FXD,COMP:2.7 OHM,5%,0.25W	01121	CB27G5
R246	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R247	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R252	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R253	307-0103-00			RES.,FXD,COMP:2.7 OHM,5%,0.25W	01121	CB27G5
R254	315-0562-00			RES.,FXD,COMP:5.6K OHM,5%,0.25W	01121	CB5625
T21	120-0827-00			XFMR,TOROID:THREE 12 TURN WINDINGS	80009	120-0827-00
U31	156-0162-00			MICROCIRCUIT,LI:DIFFERENTIAL VIDEO AMPL	07263	UA7330M
U41	156-0162-00			MICROCIRCUIT,LI:DIFFERENTIAL VIDEO AMPL	07263	UA7330M
U51	156-0096-00			MICROCIRCUIT,LI:VOLTAGE COMPARATOR	27014	LM311H
U251	156-0072-00			MICROCIRCUIT,DI:MONOSTABLE MV,TTL	12040	DM74121N
A4	670-2314-00	B010100	B039999	CKT BOARD ASSY:STORAGE	80009	670-2314-00
A4	670-2314-01	B040000	B069999	CKT BOARD ASSY:STORAGE	80009	670-2314-01
A4	670-2314-02	B070000	B091029	CKT BOARD ASSY:STORAGE	80009	670-2314-02
A4	670-2314-03	B091030		CKT BOARD ASSY:STORAGE	80009	670-2314-03
C11	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	72982	301-000X5P0121K
C12	290-0260-00			CAP.,FXD,ELCTLT:50UF,+75-10%,200V	56289	340506G200GL4
C22	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C41	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C43	283-0013-00			CAP.,FXD,CER DI:0.01UF,+100-0%,1000V	56289	33C29A7
C44	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C53	281-0550-00			CAP.,FXD,CER DI:120PF,10%,500V	72982	301-000X5P0121K
C104	281-0543-00	XB040000		CAP.,FXD,CER DI:270PF,10%,500V	72982	301-055X5P1271K
C113	283-0002-00			CAP.,FXD,CER DI:0.01UF,+80-20%,500V	72982	811-546E103Z
C142	283-0128-00			CAP.,FXD,CER DI:100PF,5%,500V	72982	871-536T2H101J
C206	283-0128-00			CAP.,FXD,CER DI:100PF,5%,500V	72982	871-536T2H101J
C232	290-0284-00			CAP.,FXD,ELCTLT:4.7UF,10%,35V	56289	150D475X9035B2
C235	290-0524-00			CAP.,FXD,ELCTLT:4.7UF,20%,10V	90201	TDC475M010EL
C251	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
CR26	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR31	152-0040-00			SEMICOND DEVICE:SILICON,600V,1A	14099	SC6
CR32	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR101	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR132	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR134	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR135	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR136	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR152	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR201	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR213	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR222	152-0107-00			SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR223	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR233	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR246	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
Q27	151-0190-00			TRANSISTOR:SILICON,NPN	04713	2N3904
Q31	151-0311-01			TRANSISTOR:SILICON,NPN	04713	MJE340
Q53	151-0358-00	B010100	B091029	TRANSISTOR:SILICON,NPN,SEL FROM D44R4	80009	151-0358-00
Q53	151-0423-00	B091030		TRANSISTOR:SILICON,NPN	01295	TIP50
Q101	151-0219-00			TRANSISTOR:SILICON,PNP	07263	SS22650
Q102	151-0219-00			TRANSISTOR:SILICON,PNP	07263	SS22650
Q103	151-0219-00			TRANSISTOR:SILICON,PNP	07263	SS22650
Q111	151-0358-00			TRANSISTOR:SILICON,NPN,SEL FROM D44R4	80009	151-0358-00
Q121	151-0311-01			TRANSISTOR:SILICON,NPN	04713	MJE340
Q131	151-0311-01			TRANSISTOR:SILICON,NPN	04713	MJE340
Q132	151-0219-00			TRANSISTOR:SILICON,PNP	07263	SS22650
Q135	151-0219-00			TRANSISTOR:SILICON,PNP	07263	SS22650
Q141	151-0219-00			TRANSISTOR:SILICON,PNP	07263	SS22650
Q151	151-0311-01			TRANSISTOR:SILICON,NPN	04713	MJE340
Q153	151-0423-00			TRANSISTOR:SILICON,NPN	01295	TIP50
Q253	151-0358-00	B010100	B091029	TRANSISTOR:SILICON,NPN,SEL FROM D44R4	80009	151-0358-00
Q253	151-0423-00	B091030		TRANSISTOR:SILICON,NPN	01295	TIP50
R1	305-0274-00			RES.,FXD,COMP:270K OHM,5%,2W	01121	HB2745
R2	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R3	315-0182-00			RES.,FXD,COMP:1.8K OHM,5%,0.25W	01121	CB1825
R4	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	75042	CEAT0-3011F
R5	305-0104-00			RES.,FXD,COMP:100K OHM,5%,2W	01121	HB1045
R11	304-0101-00			RES.,FXD,COMP:100 OHM,10%,1W	01121	GB1011
R12	303-0563-00			RES.,FXD,COMP:56K OHM,5%,1W	01121	GB5635
R20	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R21	303-0104-00			RES.,FXD,COMP:100K OHM,5%,1W	01121	GB1045
R22	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R23	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R24	315-0104-00			RES.,FXD,COMP:100K OHM,5%,0.25W	01121	CB1045
R25	315-0154-00			RES.,FXD,COMP:150K OHM,5%,0.25W	01121	CB1545
R27	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R31	315-0104-00			RES.,FXD,COMP:100K OHM,5%,0.25W	01121	CB1045
R32	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R33	305-0224-00			RES.,FXD,COMP:220K OHM,5%,2W	01121	HB2245
R41	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R42	308-0213-00			RES.,FXD,WW:25K OHM,5%,7W	14193	SAV82
R43	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R44	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R51	308-0213-00			RES.,FXD,WW:25K OHM,5%,7W	14193	SAV82
R52	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R53	315-0470-00			RES.,FXD,COMP:47 OHM,5%,0.25W	01121	CB4705
R101	315-0133-00			RES.,FXD,COMP:13K OHM,5%,0.25W	01121	CB1335
R103	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	80294	3389F-P31-103
R104	321-0270-00			RES.,FXD,FILM:6.34K OHM,1%,0.125W	75042	CEAT0-6341F
R111	315-0682-00			RES.,FXD,COMP:6.8K OHM,5%,0.25W	01121	CB6825
R112	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R113	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R114	315-0470-00	XB070000		RES.,FXD,COMP:47 OHM,5%,0.25W	01121	CB4705
R122	315-0182-00			RES.,FXD,COMP:1.8K OHM,5%,0.25W	01121	CB1825
R123	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R124	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R125	315-0133-00			RES.,FXD,COMP:13K OHM,5%,0.25W	01121	CB1335

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R126	315-0223-00			RES.,FXD,COMP:22K OHM,5%,0.25W	01121	CB2235
R132	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R133	315-0152-00			RES.,FXD,COMP:1.5K OHM,5%,0.25W	01121	CB1525
R134	315-0222-00			RES.,FXD,COMP:2.2K OHM,5%,0.25W	01121	CB2225
R137	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R140	321-0395-00			RES.,FXD,FILM:127K OHM,1%,0.125W	75042	CEAT0-1273F
R141	315-0682-00			RES.,FXD,COMP:6.8K OHM,5%,0.25W	01121	CB6825
R142	323-0452-00			RES.,FXD,FILM:499K OHM,1%,0.50W	75042	CECT0-4993F
R143	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R152	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R201	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R202	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R203	315-0133-00			RES.,FXD,COMP:13K OHM,5%,0.25W	01121	CB1335
R204	315-0182-00			RES.,FXD,COMP:1.8K OHM,5%,0.25W	01121	CB1825
R205	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	75042	CEAT0-4991F
R206	321-0307-00			RES.,FXD,FILM:15.4K OHM,1%,0.125W	75042	CEAT0-1542F
R211	321-0363-00			RES.,FXD,FILM:59K OHM,1%,0.125W	75042	CEAT0-5902F
R212	323-0398-00			RES.,FXD,FILM:137 OHM,1%,0.5W	75042	CECT0137KF
R213	304-0470-00			RES.,FXD,COMP:47 OHM,10%,1W	01121	GB4701
R221	315-0182-00			RES.,FXD,COMP:1.8K OHM,5%,0.25W	01121	CB1825
R222	315-0104-00			RES.,FXD,COMP:100K OHM,5%,0.25W	01121	CB1045
R223	315-0222-00			RES.,FXD,COMP:2.2K OHM,5%,0.25W	01121	CB2225
R232	315-0104-00			RES.,FXD,COMP:100K OHM,5%,0.25W	01121	CB1045
R233	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R234	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R235	315-0124-00			RES.,FXD,COMP:120K OHM,5%,0.25W	01121	CB1245
R241	321-0317-00			RES.,FXD,FILM:19.6K OHM,1%,0.125W	75042	CEAT0-1962F
R242	321-0324-00			RES.,FXD,FILM:23.2K OHM,1%,0.125W	75042	CEAT0-2322F
R243	315-0682-00			RES.,FXD,COMP:6.8K OHM,5%,0.25W	01121	CB6825
R244	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R245	315-0470-00			RES.,FXD,COMP:47 OHM,5%,0.25W	01121	CB4705
R246	301-0224-00			RES.,FXD,COMP:220K OHM,5%,0.50W	01121	EB2245
R254	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
A5	670-2304-00			CKT BOARD ASSY:POWER SUPPLY	80009	670-2304-00
C2	290-0524-00			CAP.,FXD,ELCTLT:4.7UF,20%,10V	90201	TDC475M010EL
C11	283-0028-00			CAP.,FXD,CER DI:0.0022UF,20%,50V	56289	19C606
C20	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131N075651104M
C60	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8131N075651104M
C61	283-0028-00			CAP.,FXD,CER DI:0.0022UF,20%,50V	56289	19C606
C62	283-0028-00			CAP.,FXD,CER DI:0.0022UF,20%,50V	56289	19C606
C101	290-0535-00			CAP.,FXD,ELCTLT:33UF,20%,10V	56289	196D336X0010KA1
C121A,B	290-0549-00			CAP.,FXD,ELCTLT:150UF,400VDC/250VDC	56289	68D20193
C131	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C141	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C142	290-0506-00			CAP.,FXD,ELCTLT:9600UF,+100-10%,25V	56289	68D10471
C201	290-0569-00			CAP.,FXD,ELCTLT:50UF,+75-10%,250V	56289	TYPE 66D
C222	290-0510-00			CAP.,FXD,ELCTLT:6000UF,+100-10%,15V	56289	66D10327
C242	290-0506-00			CAP.,FXD,ELCTLT:9600UF,+100-10%,25V	56289	68D10471
CR31	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR32	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR41	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR52	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR101	152-0497-00			SEMICOND DEVICE:SILICON,600V,1.5A	06288	PD60
CR102	152-0497-00			SEMICOND DEVICE:SILICON,600V,1.5A	06288	PD60
CR201	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	80009	152-0488-00
F31	159-0015-00			FUSE,CARTRIDGE:3AG,3A,250V,FAST-BLOW	71400	AGC3
F41	159-0021-00			FUSE,CARTRIDGE:3AG,2A,250V,FAST-BLOW	71400	AGC2
Q23	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q24	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q42	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q51	151-0134-00			TRANSISTOR:SILICON,PNP	04713	2N2905A
Q62	151-0188-00			TRANSISTOR:SILICON,PNP	04713	2N3906
R2	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R11	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	75042	CEAT0-2001F
R12	311-1225-00			RES.,VAR,NONWIR:1K OHM,20%,0.50W	80294	3389F-P31-102
R20	315-0622-00			RES.,FXD,COMP:6.2K OHM,5%,0.25W	01121	CB6225
R21	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	75042	CEAT0-3011F
R22	321-0200-00			RES.,FXD,FILM:1.18K OHM,1%,0.125W	75042	CEAT0-1181F
R23	315-0391-00			RES.,FXD,COMP:390 OHM,5%,0.25W	01121	CB3915
R24	307-0093-00			RES.,FXD,COMP:1.2 OHM,5%,0.50W	01121	EB12G5
R25	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R41	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R52	307-0093-00			RES.,FXD,COMP:1.2 OHM,5%,0.50W	01121	EB12G5
R53	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R54	315-0391-00			RES.,FXD,COMP:390 OHM,5%,0.25W	01121	CB3915
R61	315-0622-00			RES.,FXD,COMP:6.2K OHM,5%,0.25W	01121	CB6225
R63	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R64	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R65	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	75042	CEAT0-1002F
R121	306-0154-00			RES.,FXD,COMP:150K OHM,10%,2W	01121	HB1541
R141	301-0134-00			RES.,FXD,COMP:130K OHM,5%,0.50W	01121	EB1345
R221	304-0154-00			RES.,FXD,COMP:150K OHM,10%,1W	01121	GB1541
R222	304-0681-00			RES.,FXD,COMP:680 OHM,10%,1W	01121	GB6811
U11	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U64	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
VR2	152-0461-00			SEMICOND DEVICE:ZENER,0.4W,6.2V,5%	04713	1N821
VR42	152-0147-00			SEMICOND DEVICE:ZENER,400MW,27V,5%	81483	1N971B
A6	670-2308-00	B010100	B029999	CKT BOARD ASSY:HIGH VOLTAGE	80009	670-2308-00
A6	670-2308-01	B030000		CKT BOARD ASSY:HIGH VOLTAGE	80009	670-2308-01
C12	283-0034-00			CAP.,FXD, CER DI:0.005UF,20%,4000V	56289	41C107A7-S2057
C13	283-0034-00			CAP.,FXD, CER DI:0.005UF,20%,4000V	56289	41C107A7-S2057
C131	283-0291-00			CAP.,FXD,CER DI:25PF,10%,6000V	72982	3878546C0G250K
C132	283-0101-00			CAP.,FXD,CER DI:4700PF,+80-20%,6000V	56289	45C11A
C141	283-0101-00			CAP.,FXD,CER DI:4700PF,+80-20%,6000V	56289	45C11A
C142	283-0101-00			CAP.,FXD,CER DI:4700PF,+80-20%,6000V	56289	45C11A
C151	283-0101-00			CAP.,FXD,CER DI:4700PF,+80-20%,6000V	56289	45C11A

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C152	283-0101-00			CAP.,FXD,CER DI:4700PF,+80-20%,6000V	56289	45C11A
C161	283-0101-00			CAP.,FXD,CER DI:4700PF,+80-20%,6000V	56289	45C11A
C162	283-0101-00			CAP.,FXD,CER DI:4700PF,+80-20%,6000V	56289	45C11A
C202	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039651105Z
C203	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	72982	835-515B102K
C241	283-0008-00			CAP.,FXD,CER DI:0.1UF,500V	72982	8151N501651104M
C251	283-0008-00			CAP.,FXD,CER DI:0.1UF,500V	72982	8151N501651104M
C272	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C301	290-0559-00			CAP.,FXD,ELCTLT:22UF,20%,35V	56289	196D226X0035MA1
C312	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C313	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C320	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
C321	281-0604-00			CAP.,FXD,CER DI:2.2PF,+/-0.25PF,500V	72982	301-000C0J0229C
C322	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-000C0G0100F
C333	283-0078-00			CAP.,FXD,CER DI:0.001UF,20%,500V	56289	20C114A8
C337	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C352	283-0005-00			CAP.,FXD,CER DI:0.01UF,+100-0%,250V	72982	8131-250651103P
C364	281-0511-00			CAP.,FXD,CER DI:22PF,+/-2.2PF,500V	72982	301-000C0G0220K
C372	281-0547-00			CAP.,FXD,CER DI:2.7PF,10%,500V	72982	301-000C0J0279C
C441	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C451	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C452	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	72982	301-000X5U0471M
C461	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	56289	19C241
C475	281-0572-00			CAP.,FXD,CER DI:6.8PF,+/-0.5PF,500V	72982	301-000C0H0689D
CR11	152-0408-00			SEMICOND DEVICE:SILICON,25V,5MA	14099	SA2055
CR12	152-0408-00			SEMICOND DEVICE:SILICON,25V,5MA	14099	SA2055
CR31	152-0408-00			SEMICOND DEVICE:SILICON,25V,5MA	14099	SA2055
CR32	152-0408-00			SEMICOND DEVICE:SILICON,25V,5MA	14099	SA2055
CR51	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	12969	NDP341
CR62	152-0242-00			SEMICOND DEVICE:SILICON,225V,200MA	12969	NDP341
CR201	152-0412-00			SEMICOND DEVICE:SILICON,50V,3A	04713	SR1936
CR220	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR221	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR242	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR243	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR251	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR252	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR253	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR254	152-0061-00	XB010201		SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR261	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR265	152-0107-00	B010100	B010299X	SEMICOND DEVICE:SILICON,375V,400MA	80009	152-0107-00
CR271	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR351	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR355	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR361	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR362	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR363	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR373	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR374	152-0066-00			SEMICOND DEVICE:SILICON,400V,750MA	02735	37304
CR401	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR425	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR426	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152
CR443	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	07910	1N4152

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
DS33	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS41	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS42	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS43	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS51	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS52	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS61	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS62	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS261	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS262	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS263	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS264	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS265	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS271	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS272	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
DS273	150-0035-00			LAMP,GLOW:90V,0.3MA	08806	A1D-T
L301	108-0234-00			COIL,RF:130UH,5%	80009	108-0234-00
L311	108-0422-00			COIL,RF:80UH	80009	108-0422-00
L361	108-0213-00			COIL,RF:2.5MH,5%	76493	8862-2.5
Q235	151-0311-01			TRANSISTOR:SILICON,NPN	04713	MJE340
Q261	151-0279-00			TRANSISTOR:SILICON,NPN	07263	S25381
Q271	151-0169-00			TRANSISTOR:SILICON,NPN	02735	2N3439
Q315	151-0334-00			TRANSISTOR:SILICON,NPN	80009	151-0334-00
Q320	151-0302-00			TRANSISTOR:SILICON,NPN	04713	2N2222A
Q321	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	15818	U1490
Q324	151-0279-00			TRANSISTOR:SILICON,NPN	07263	S25381
Q345	151-0190-00			TRANSISTOR:SILICON,NPN	04713	2N3904
Q351	151-0270-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N3495	80009	151-0270-00
Q352	151-0124-00			TRANSISTOR:SILICON,NPN,SEL FROM 2N3501	80009	151-0124-00
Q353	151-0279-00			TRANSISTOR:SILICON,NPN	07263	S25381
Q371	151-0169-00			TRANSISTOR:SILICON,NPN	02735	2N3439
Q433	151-0279-00			TRANSISTOR:SILICON,NPN	07263	S25381
R42	301-0101-00			RES.,FXD,COMP:100 OHM,5%,0.50W	01121	EB1015
R43	301-0101-00			RES.,FXD,COMP:100 OHM,5%,0.50W	01121	EB1015
R44	301-0273-00			RES.,FXD,COMP:27K OHM,5%,0.50W	01121	EB2735
R51	301-0104-00			RES.,FXD,COMP:100K OHM,5%,0.5W	01121	EB1045
R52	301-0395-00			RES.,FXD,COMP:3.9M OHM,5%,0.50W	01121	EB3955
R53	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R54	315-0102-00	B010100	B059999	RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R54	315-0102-03	B060000		RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R141A	307-0314-00			RES.,FXD,FILM:VOLTAGE DIVIDER	80009	307-0314-00
R141B	307-0314-00			RES.,FXD,FILM:VOLTAGE DIVIDER	80009	307-0314-00
R161A	307-0316-00			RES.,FXD,FILM:26.8M OHM	80009	307-0316-00
R161B	307-0316-00			RES.,FXD,FILM:15M OHM	80009	307-0316-00
R171	311-1459-00			RES.,VAR,NONWIR:PNL,5 M OHM,2W	01121	11M027A
R202	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R224	315-0104-00			RES.,FXD,COMP:100K OHM,5%,0.25W	01121	CB1045
R225	321-0423-00			RES.,FXD,FILM:249K OHM,1%,0.125W	75042	CEAT0-2493F
R226	311-1232-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	80294	3389F-P31-503
R232	315-0824-00			RES.,FXD,COMP:820K OHM,5%,0.25W	01121	CB8245
R233	315-0224-00			RES.,FXD,COMP:220K OHM,5%,0.25W	01121	CB2245
R234	311-1232-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	80294	3389F-P31-503

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R241	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	80294	3389F-P31-104
R242	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R251	315-0471-00			RES.,FXD,COMP:470 OHM,5%,0.25W	01121	CB4715
R252	305-0125-00			RES.,FXD,COMP:1.2M OHM,5%,2W	01121	HB1255
R253	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R255	315-0202-00			RES.,FXD,COMP:2K OHM,5%,0.25W	01121	CB2025
R261	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R265	315-0221-00	XB010300		RES.,FXD,COMP:220 OHM,5%,0.25W	01121	CB2215
R266	315-0333-00			RES.,FXD,COMP:33K OHM,5%,0.25W	01121	CB3335
R271	315-0222-00			RES.,FXD,COMP:2.2K OHM,5%,0.25W	01121	CB2225
R311	301-0272-00			RES.,FXD,COMP:2.7K OHM,5%,0.50W	01121	EB2725
R312	315-0221-00			RES.,FXD,COMP:220 OHM,5%,0.25W	01121	CB2215
R314	315-0272-00			RES.,FXD,COMP:2.7K OHM,5%,0.25W	01121	CB2725
R315	304-0152-00			RES.,FXD,COMP:1.5K OHM,10%,1W	01121	GB1521
R316	321-0280-00			RES.,FXD,FILM:8.06K OHM,1%,0.125W	75042	CEAT0-8061F
R320	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R323	305-0473-00			RES.,FXD,COMP:47K OHM,5%,2W	01121	HB4735
R324	321-0411-00			RES.,FXD,FILM:187K OHM,1%,0.125W	75042	CEAT0-1873F
R325	305-0393-00			RES.,FXD,COMP:39K OHM,5%,2W	01121	HB3935
R331	315-0124-00	B010100	B029999	RES.,FXD,COMP:120K OHM,5%,0.25W	01121	CB1245
R331	315-0274-00	B030000		RES.,FXD,COMP:270K OHM,5%,0.25W	01121	CB2745
R332	321-0299-00	B010100	B029999	RES.,FXD,FILM:12.7K OHM,1%,0.125W	75042	CEAT0-1272F
R332	321-0266-00	B030000		RES.,FXD,FILM:5.76K OHM,1%,0.125W	75042	CEAT0-5761F
R333	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R334	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R335	301-0222-00			RES.,FXD,COMP:2.2K OHM,5%,0.50W	01121	EB2225
R336	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R337	315-0220-00			RES.,FXD,COMP:22 OHM,5%,0.25W	01121	CB2205
R341	315-0101-00			RES.,FXD,COMP:100 OHM,5%,0.25W	01121	CB1015
R342	321-0371-00			RES.,FXD,FILM:71.5K OHM,1%,0.125W	75042	CEAT0-7152F
R343	303-0513-00			RES.,FXD,COMP:51K OHM,5%,1W	01121	GB5135
R344	321-0403-00			RES.,FXD,FILM:154K OHM,1%,0.125W	75042	CEAT0-1543F
R345	321-0284-00			RES.,FXD,FILM:8.87K OHM,1%,0.125W	75042	CEAT0-8871F
R351	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R352	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R362	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	75042	CEAT0-4991F
R363	315-0103-00			RES.,FXD,COMP:10K OHM,5%,0.25W	01121	CB1035
R374	301-0390-00			RES.,FXD,COMP:39 OHM,5%,0.50W	01121	EB3905
R375	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R376	305-0104-00			RES.,FXD,COMP:100K OHM,5%,2W	01121	HB1045
R401	308-0244-00			RES.,FXD,WW:0.3 OHM,10%,2W	91637	RS2B162ER3000K
R412	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R413	321-0274-00			RES.,FXD,FILM:6.98K OHM,1%,0.125W	75042	CEAT0-6981F
R414	315-0100-00			RES.,FXD,COMP:10 OHM,5%,0.25W	01121	CB1005
R415	315-0335-00			RES.,FXD,COMP:3.3M OHM,5%,0.25W	01121	CB3355
R423	321-0269-00			RES.,FXD,FILM:6.19K OHM,1%,0.125W	75042	CEAT0-6191F
R424	315-0153-00			RES.,FXD,COMP:15K OHM,5%,0.25W	01121	CB1535
R425	315-0152-00			RES.,FXD,COMP:1.5K OHM,5%,0.25W	01121	CB1525
R433	315-0561-00			RES.,FXD,COMP:560 OHM,5%,0.25W	01121	CB5615
R434	307-0103-00			RES.,FXD,COMP:2.7 OHM,5%,0.25W	01121	CB27G5
R443	315-0104-00			RES.,FXD,COMP:100K OHM,5%,0.25W	01121	CB1045
R444	315-0102-00			RES.,FXD,COMP:1K OHM,5%,0.25W	01121	CB1025
R445	315-0221-00			RES.,FXD,COMP:220 OHM,5%,0.25W	01121	CB2215

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R452	315-0471-00			RES.,FXD,COMP:470 OHM,5%,0.25W	01121	CB4715
R453	315-0220-00			RES.,FXD,COMP:22 OHM,5%,0.25W	01121	CB2205
R454	315-0301-00			RES.,FXD,COMP:300 OHM,5%,0.25W	01121	CB3015
R455	315-0132-00			RES.,FXD,COMP:1.3K OHM,5%,0.25W	01121	CB1325
R461	308-0054-00			RES.,FXD,WW:10K OHM,5%,5W	56289	246EX10K00JQ151
R462	315-0470-00			RES.,FXD,COMP:47 OHM,5%,0.25W	01121	CB4705
R463	321-0239-00			RES.,FXD,FILM:3.01K OHM,1%,0.125W	75042	CEAT0-3011F
R464	315-0335-00			RES.,FXD,COMP:3.3M OHM,5%,0.25W	01121	CB3355
R471	315-0472-00			RES.,FXD,COMP:4.7K OHM,5%,0.25W	01121	CB4725
R472	311-1235-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	80294	3389F-P31-104
R473	321-0314-00			RES.,FXD,FILM:18.2K OHM,1%,0.125W	75042	CEAT0-1822F
R474	321-0440-00			RES.,FXD,FILM:374K OHM,1%,0.125W	75042	CEAT0-3743F
R475	321-0452-00			RES.,FXD,FILM:499K OHM,1%,0.125W	75042	CEAT0-4993F
T111	120-0826-00			XFMR,PWR,SDN/SU:	80009	120-0826-00
U421	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U471	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

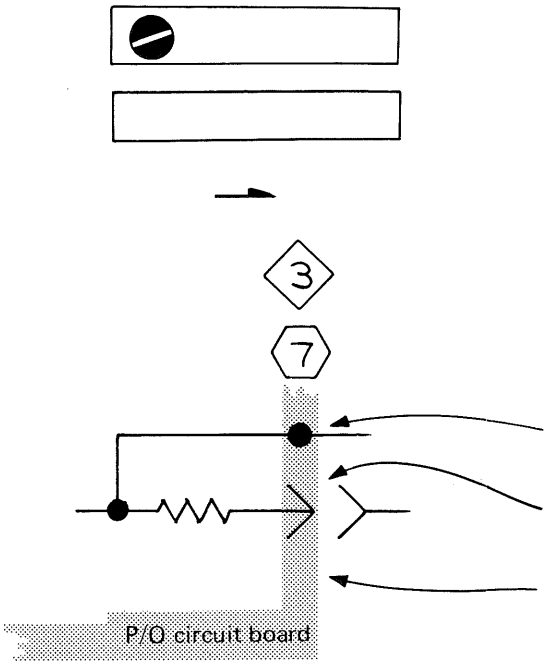
Electrical components shown on the diagrams are in the following units unless noted otherwise:

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

Symbols used on the diagrams are based on USA Standard Y32.2-1967.

Logic symbology is based on MIL-STD-806B in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following special symbols are used on the diagrams:



External Screwdriver adjustment.

External control or connector.

Clockwise control rotation in direction of arrow.

Refer to diagram number indicated in diamond.

Refer to waveform number indicated in hexagon.

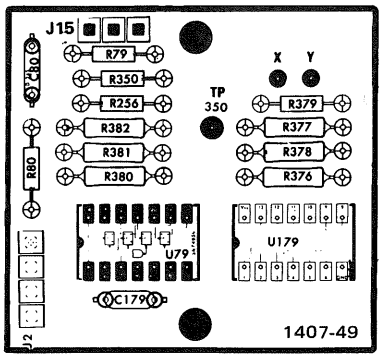
Connection soldered to circuit board.

Connection made to circuit board with interconnecting pin.

Blue tint encloses components located on circuit board.

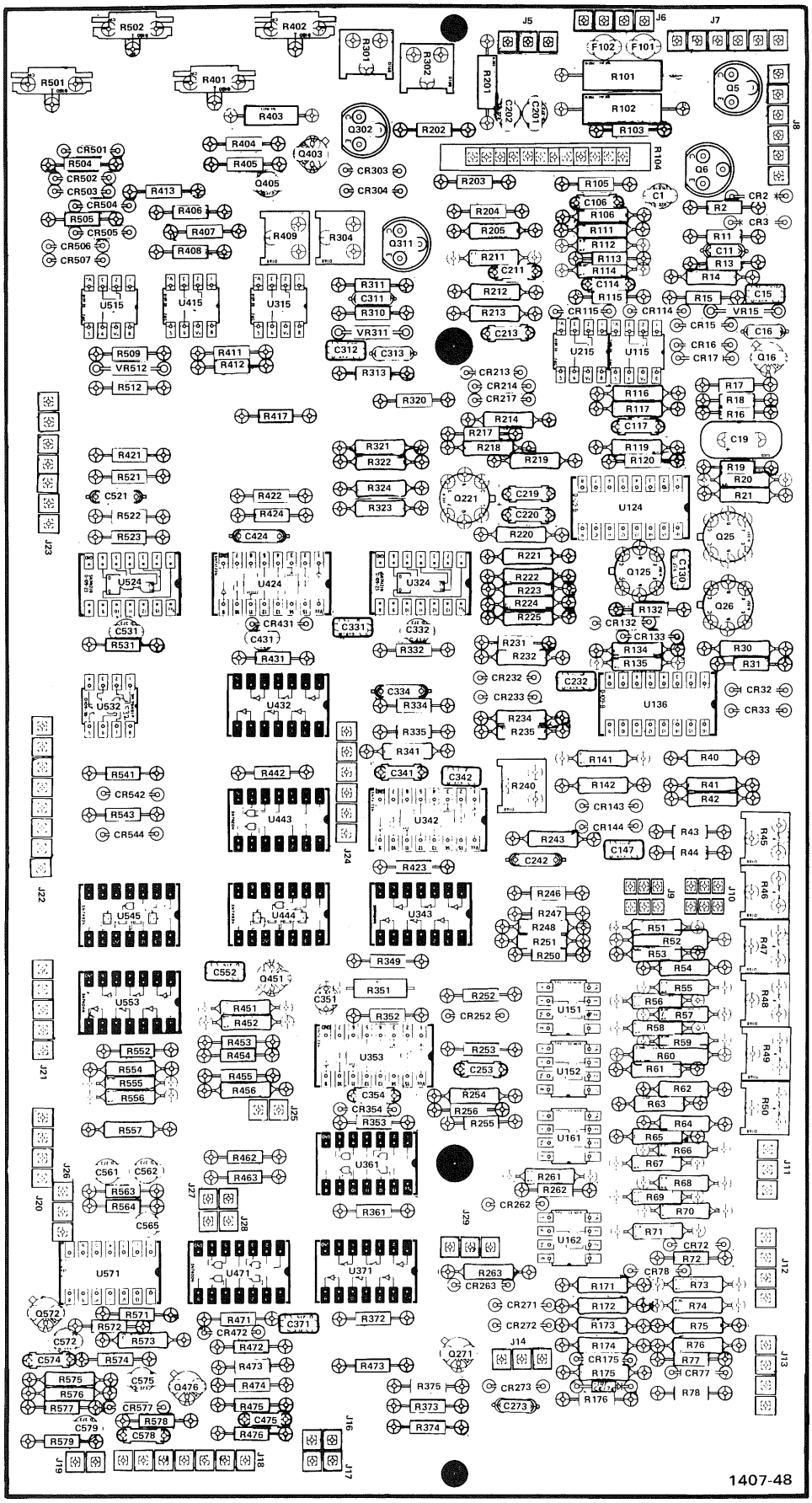
The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc.)
AT	Attenuator, fixed or variable
B	Motor
BT	Battery
C	Capacitor, fixed or variable
CR	Diode, signal or rectifier
DL	Delay line
DS	Indicating device (lamp)
F	Fuse
FL	Filter
H	Heat dissipating device (heat sink, heat radiator, etc.)
HR	Heater
J	Connector, stationary portion
K	Relay
L	Inductor, fixed or variable
LR	Inductor/resistor combination
M	Meter
Q	Transistor or silicon-controlled rectifier
P	Connector, movable portion
R	Resistor, fixed or variable
RT	Thermistor
S	Switch
T	Transformer
TP	Test point
U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
V	Electron tube
VR	Voltage regulator (zener diode, etc.)
Y	Crystal



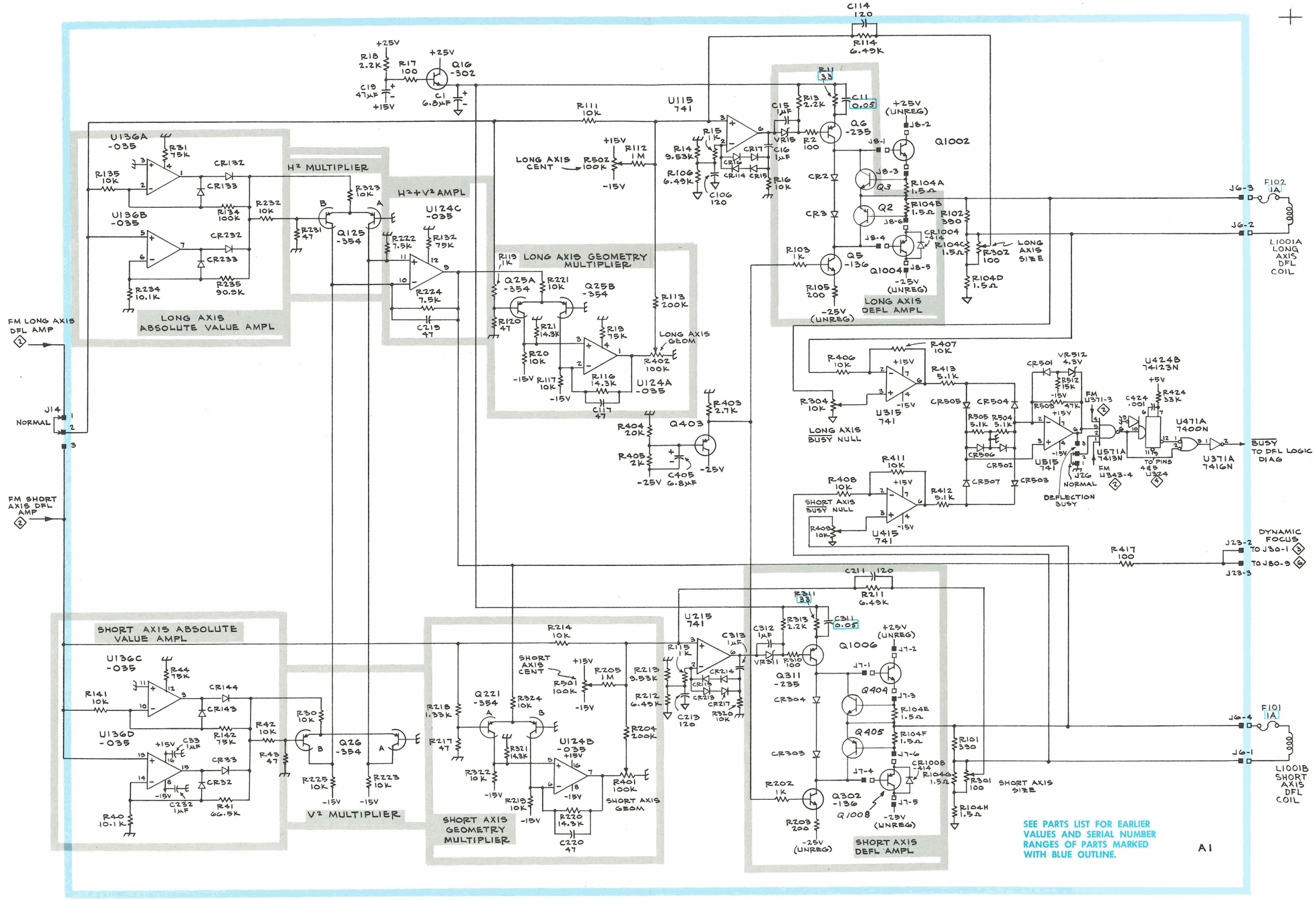
A1A Origin Shifter board, 670-2955-00.

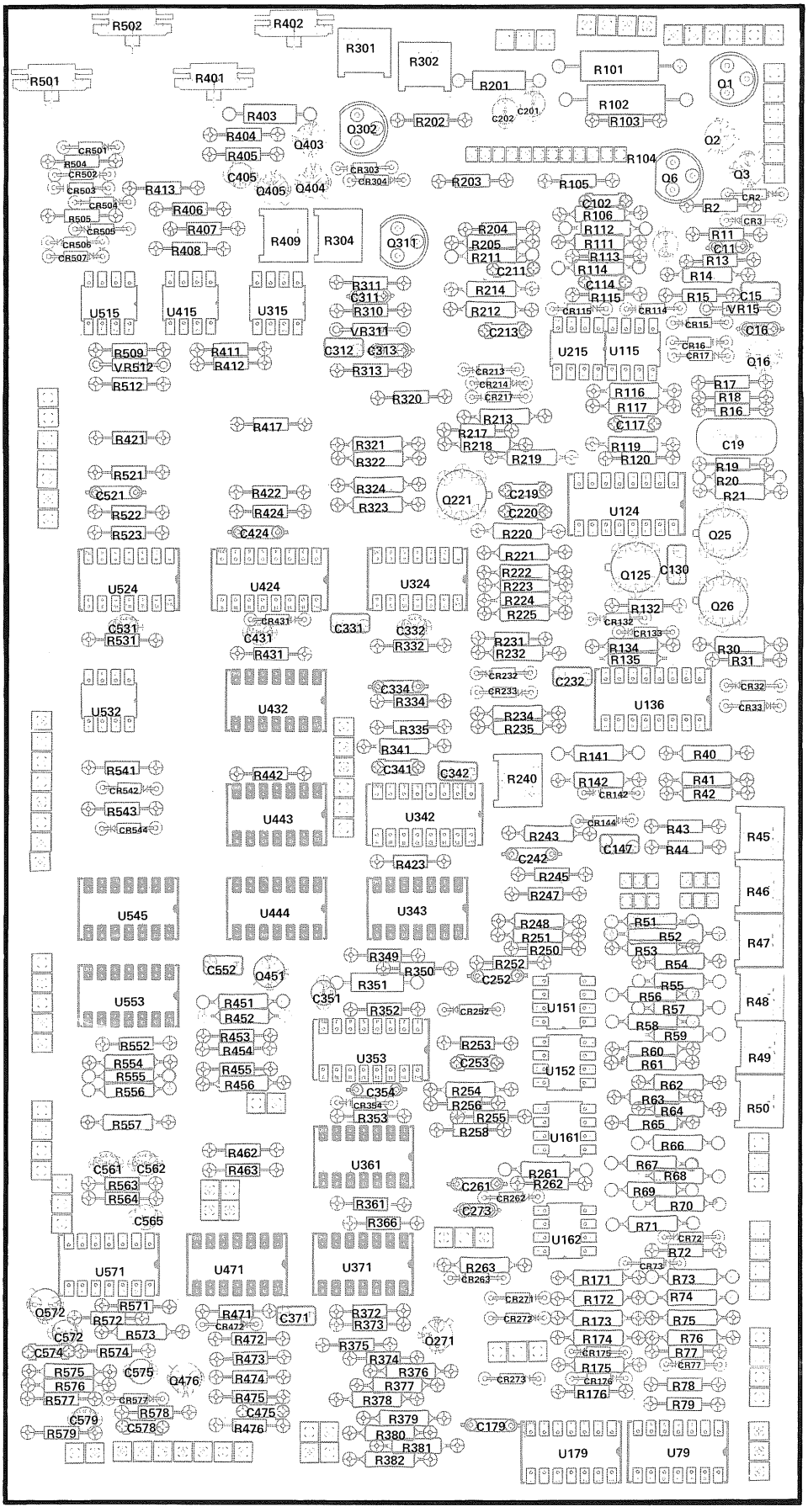
REV. B, DEC. 1974



A1 Deflection Amplifier board, 670-2303-00

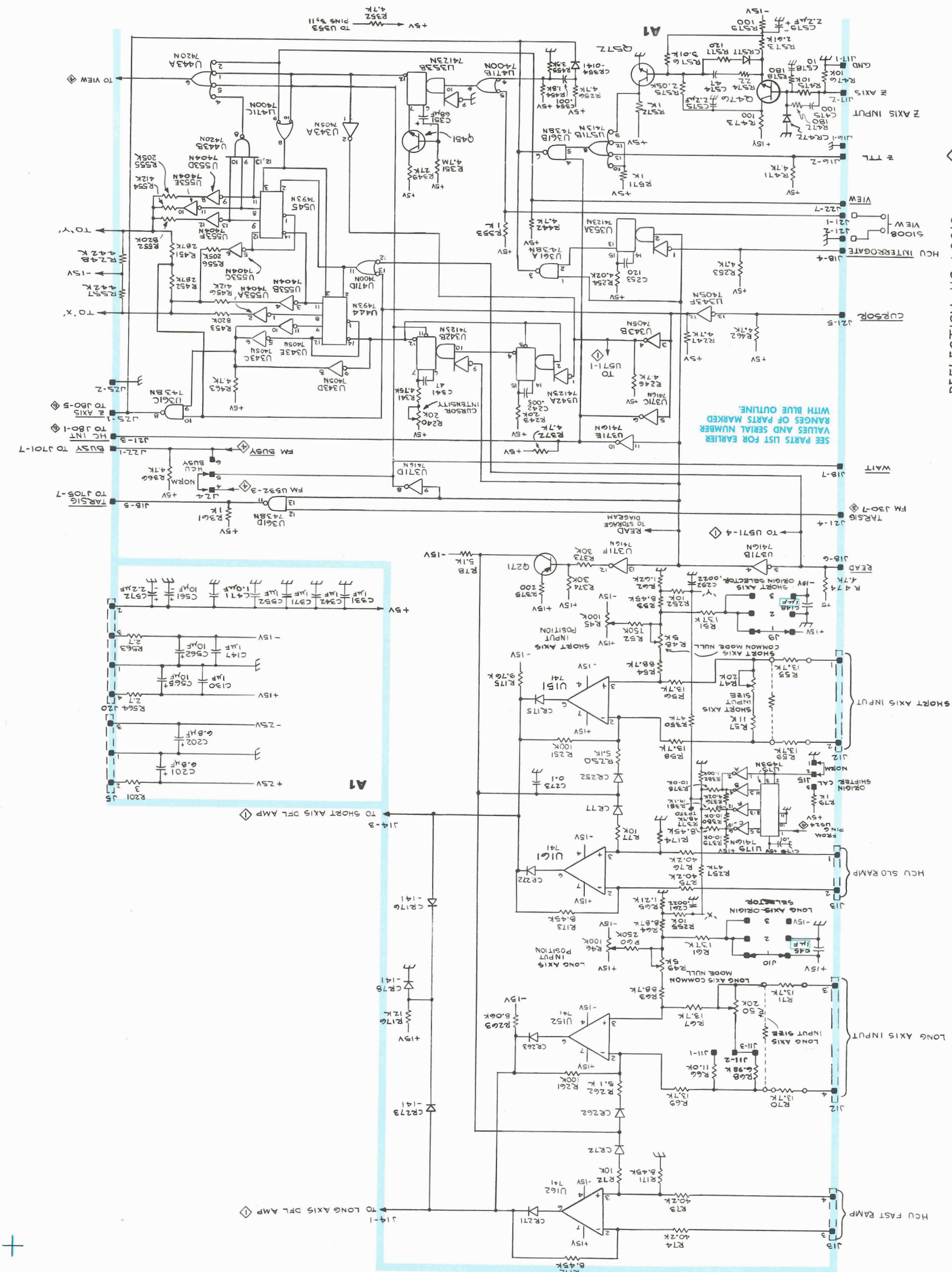
REV. B, DEC. 1974

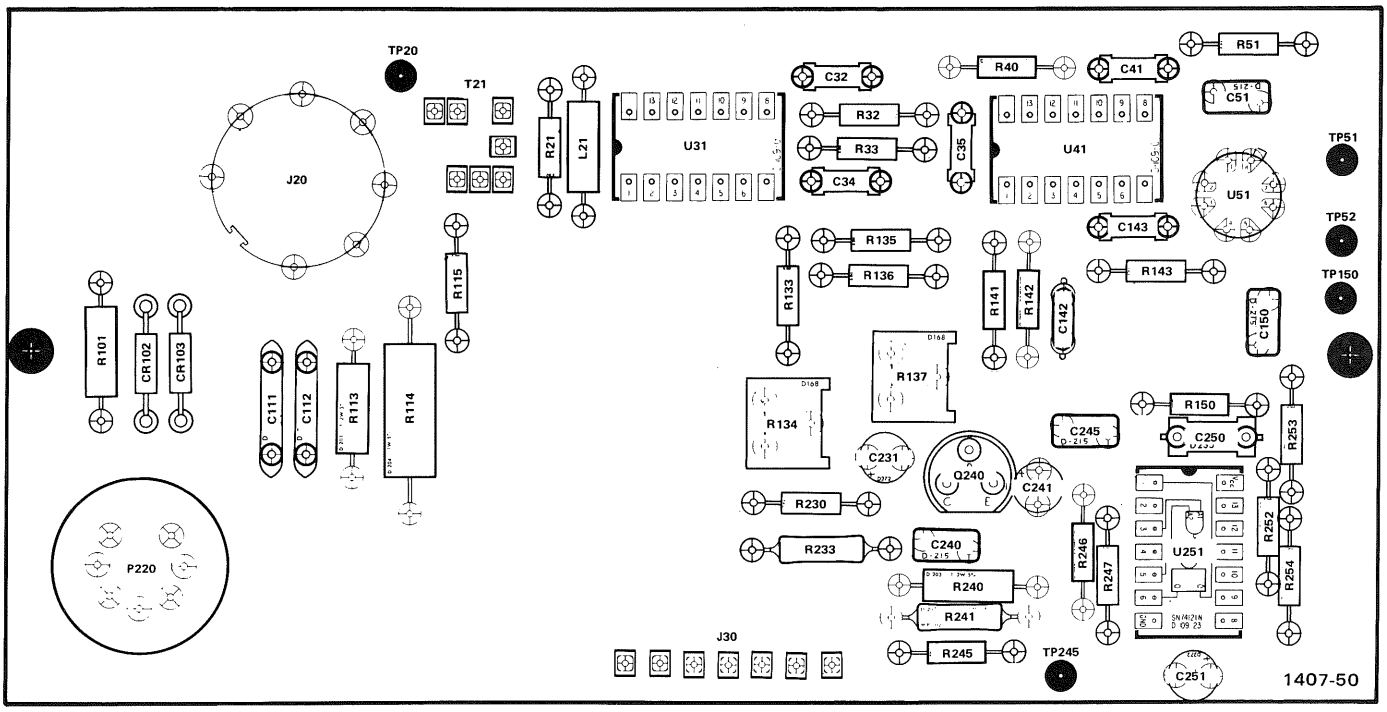

LONG AXIS ABSOLUTE VALUE AMPL
H² MULTIPLIER
H²+V² AMPL
LONG AXIS GEOMETRY MULTIPLIER
LONG AXIS DEFL AMPL
SHORT AXIS ABSOLUTE VALUE AMPL
V² MULTIPLIER
SHORT AXIS GEOMETRY MULTIPLIER
SHORT AXIS DEFL AMPL
FM LONG AXIS DFL AMP
FM SHORT AXIS DFL AMP
LONG AXIS BUSY NULL
SHORT AXIS BUSY NULL
DEFLECTION BUSY
LONG AXIS SIZE
SHORT AXIS SIZE
LONG AXIS CENT
SHORT AXIS CENT
LONG AXIS GEOM
SHORT AXIS GEOM
L1001A LONG AXIS DFL COIL
L1001B SHORT AXIS DFL COIL
BUSY TO DFL LOGIC DIAG
DYNAMIC FOCUS
TO J30-1
TO J30-9
TO PINS 4&8 U324
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
A1



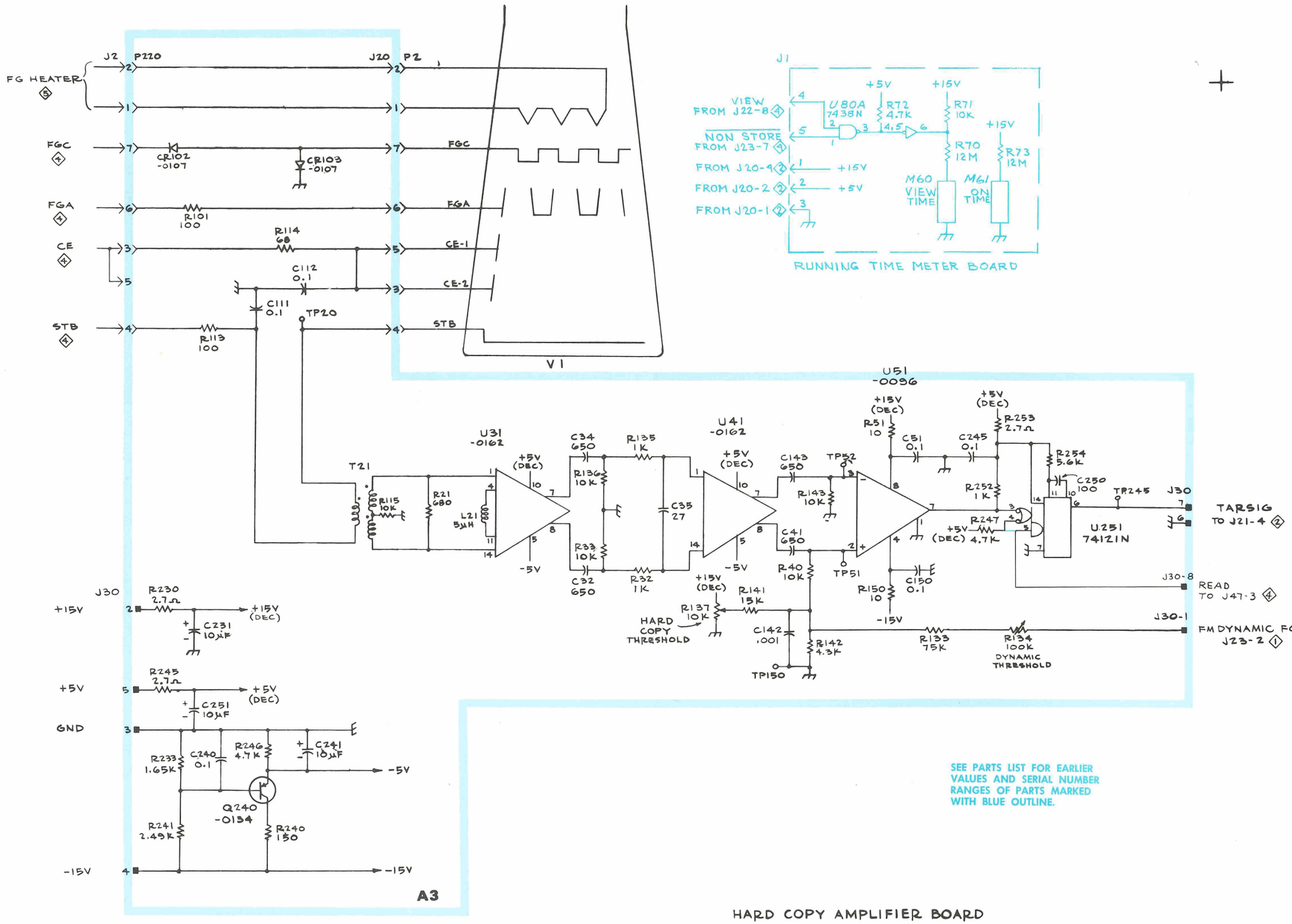
A1 Deflection Amplifier board, 670-2303-01 and up.

@

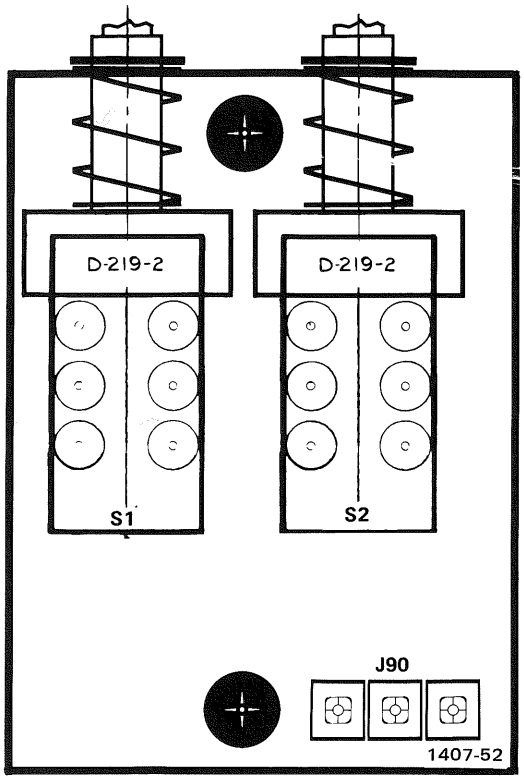

DEFLECTION HC LOGIC
CURSOR AND Z AXIS INPUT
②
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
SHORT AXIS INPUT
LONG AXIS INPUT
HCU SLO RAMP
HCU FAST RAMP
Z AXIS INPUT
A1
REV. B, DEC. 1974
6-13



A3 Hard Copy Amplifier board, 670-2306-00 and up. REV. B, DEC. 1974

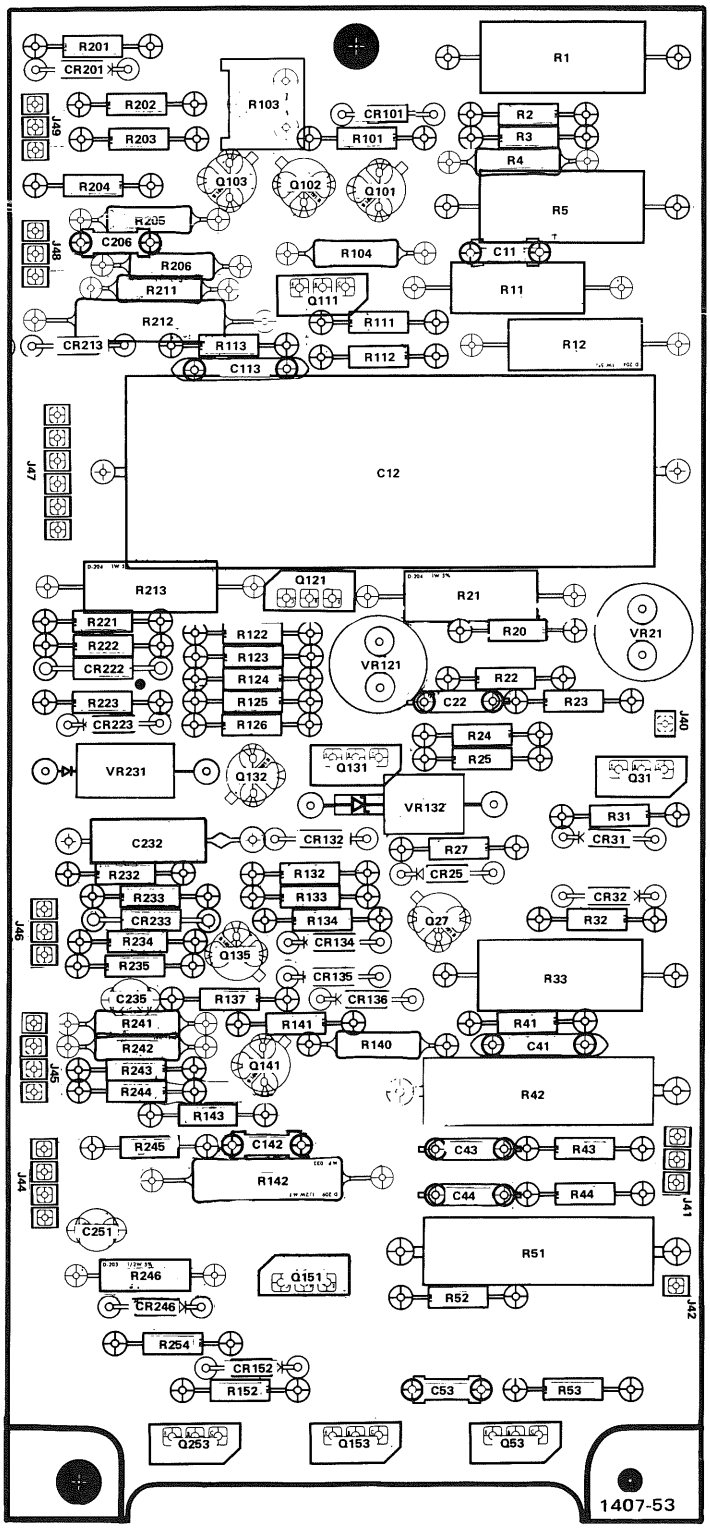


HARD COPY AMPLIFIER BOARD



A2 Front Panel Switches, 670-2305-00.

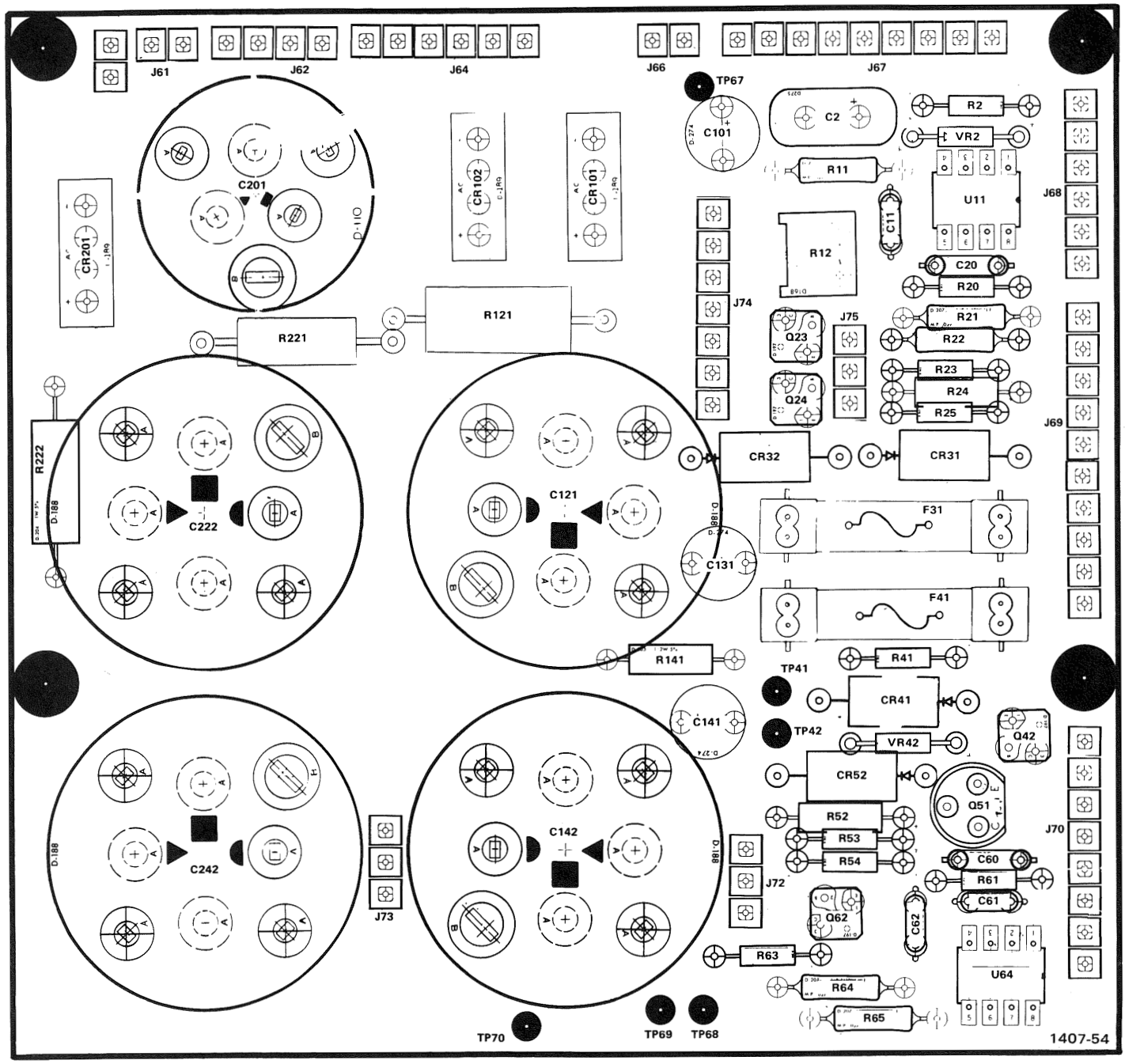
REV. B, DEC. 1974



A4 Storage board, 670-2314-00 and up.

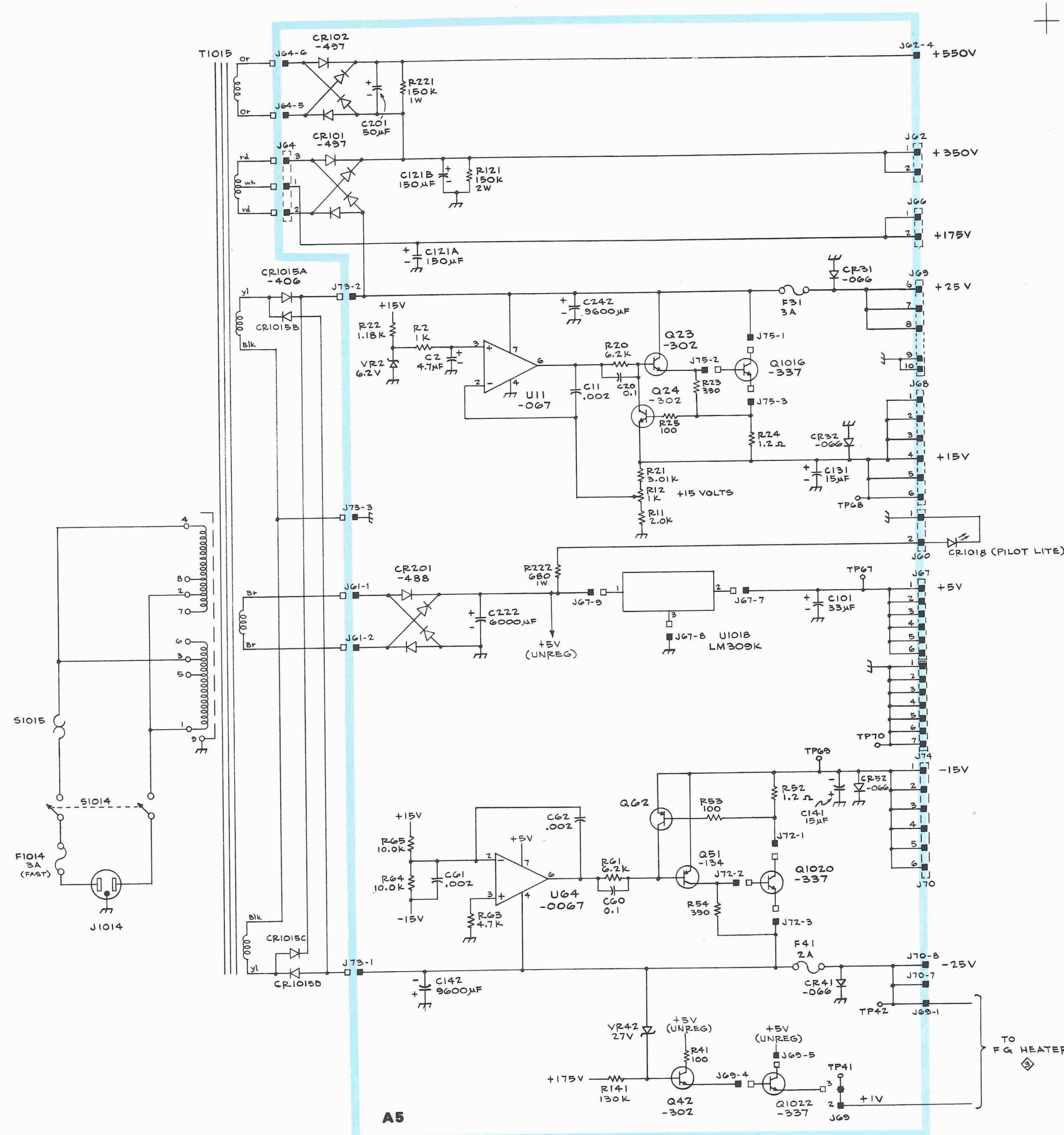
REV. B, DEC. 1974

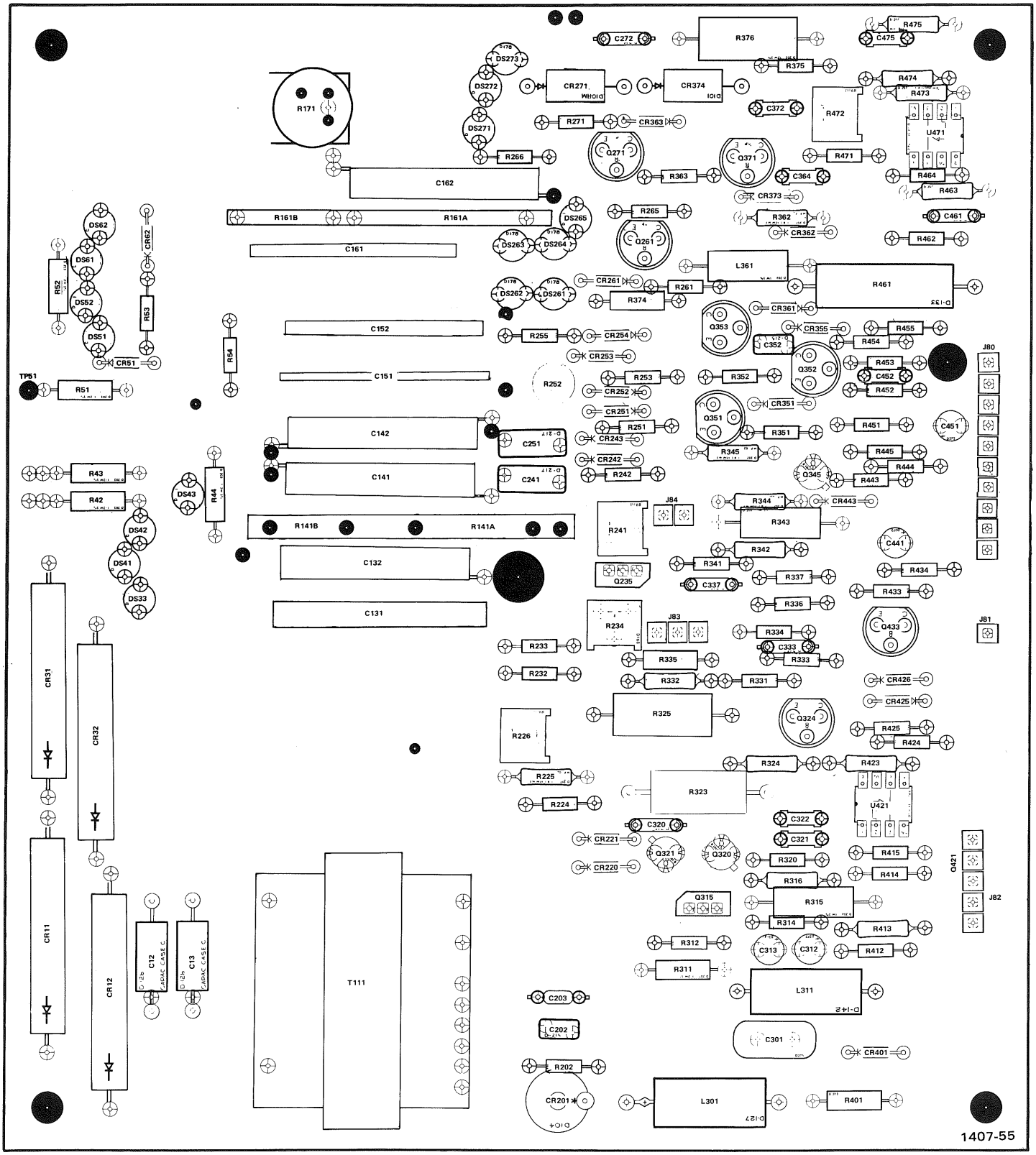
REMOTE ERASE FM J701-18
J23-6
S1010 ERASE
J23-5
J23-4
NON-STORE FM J701-6
J23-7
R335 4.7K
+5V
R421 1K
R521 1M
R522 1K
C521 .001
R523 1K
U532A TS451P
TO J24 PIN 1 (2)
C531 1μF
R531 15K
TO PIN 1 U79 (2)
U524 7412IN
U432F 7416N
J22-5
U532B TS451P
J22-6
U432D 7416N
J22-4
R543 680
CR544
CR542
R541 10K
-15V
R334 100
C334 .001
U432A 7416N
BUSY TO J22-1 (2)
R332 23K
R422 4.7K
C332 22μF
U324 74121N
TO PIN 3 & PIN 11 J24 OF U429B (1)
NORM
HCU BUSY
R431 43K
C431 33μF
CR431
U432B 7416N
U74A 74123N
U432E 7416N
R423 4.7K
READ FM U371B PIN 4 (2)
J22-3
VIEW FM U433A PIN 6 (2)
J22-8
U432C 7416N
J22-2
P/O A1
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
+15V
R223 2.2K
CR223
R241 13.6K
R242 23.2K
-15V
J45-2
R1010 10K OP LEVEL
J45-3
J45-1
R243 6.8K
J47-5
+175V
R25 150K
CR132
R132 1K
R133 1.5K
J47-6
C232 4.7μF
R233 100
CR233 R232-0333
R234 100
CR135 0185
Q135
CR134
R134 2.2K
Q27
R27 4.7K
CR26 0185
CR136 0185
R137 100
C235 4.7μF
R235 120K
J47-4
R202 1K
R204 1.8K
Q103
R203 13K
R205 4.99K
R206 15.4K
Q102
R103 10K
COLLIMATION
COLLIMATION CIRCUIT
R111 6.8K
C104 270
Q111
R114 47
R112 100
R140 127K
+550V
R5 100K
R12 56K
R1 270K
C11 120
R11 100 1W
+350V
J49-2
J49-3
Q1010
J49-1
CR201
R201 10
J48-2
R1012 1K
Q1012
J48-1
J18-3
C113 .01
CR213
R113 100
C206 100
R212 137K
J46-2
R213 47
R141 6.8K
Q151
R33 220K
R53 47
C53 120
Q153
H
R143 100
C41 .01
R41 100
CR246
R244 100
C142 100
R142 499K
R245 47
R246 220K
ERASURE MULTIVIBRATOR & STORAGE BACKPLATE AMPL
J46-1
V1
CE-2
CE-1
6 7 2 1
PS BOARD
J47-3
CR101
R2 1K
R3 1.8K
Q101
R104 6.34K
R101 13K
R4 3.01K
R211 59K
R52 100
R42 25K .7W
Q253
R152 100
CR152
R51 25K .7W
R254 100
R32 100
Q53
J47-1
R123 1K
R122 1.8K
Q31
R24 100K
Q132
R22 100
R125 13K
R124 10K
Q131
R126 22K
+328V
R31 100K
CR31
CR32
VR21 200V
VR121 200V
VR231 51V
R21 100K
R20 1K
VR132 150V
VIEW CIRCUIT
J47-2
Q121
C12 50μF
R222 100K
CR222
J42
J46-3
R43 10
C43 .01
R44 10
C44 .01
R23 10
C22 .01
C251 10μF
+550V
+350V
+175
+15
+5
-15
J41-3
J41-1
J40
J44-2
J44-4
J44-1
J44-3
STORAGE BOARD A4
STORAGE CKT (4) REVISED JAN 1974
STORAGE CIRCUIT
(4)
613
(B)



A5 Power Supply board, 670-2304-00

REV. B, DEC. 1974

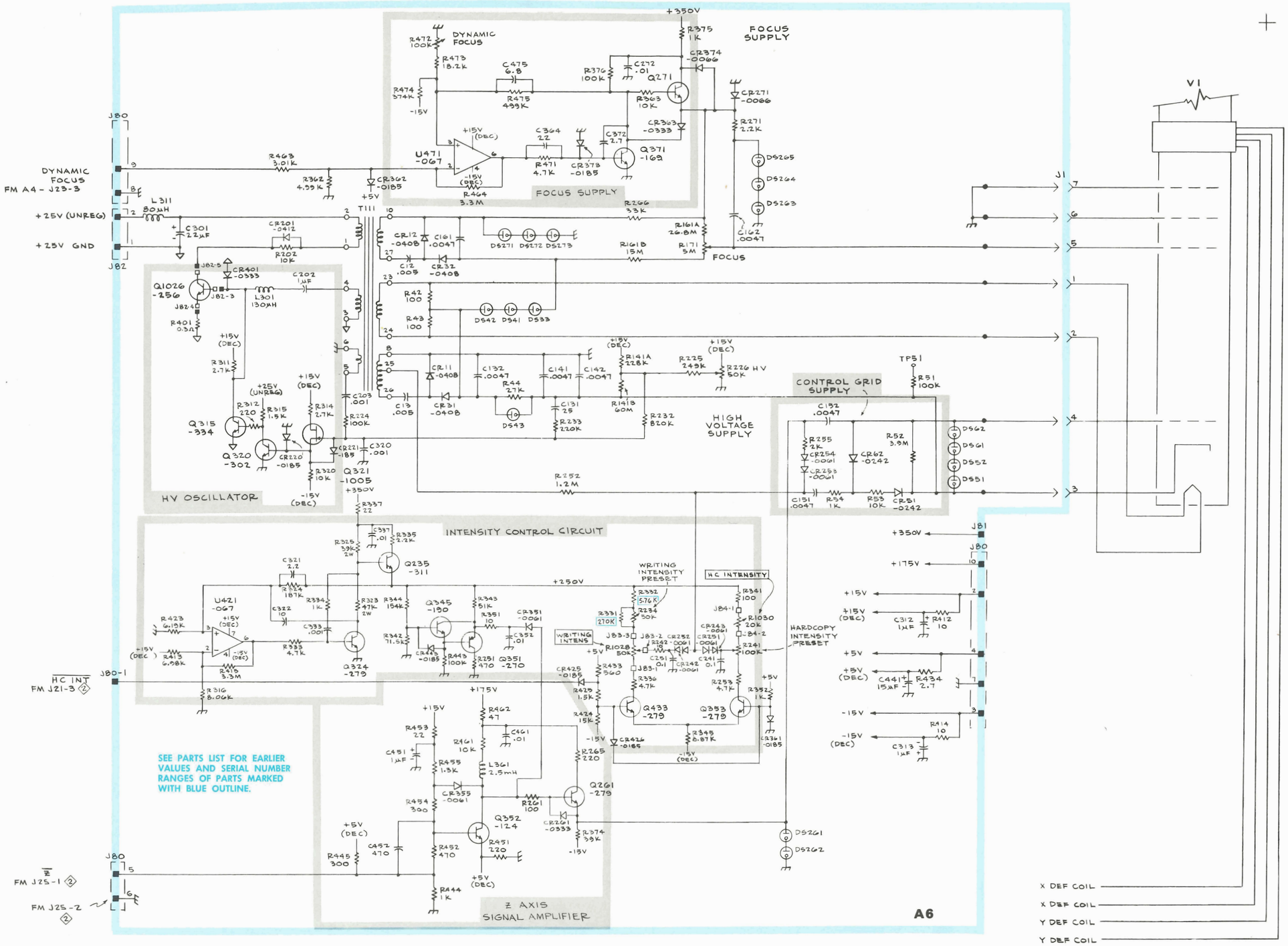

T1015
CR102 -497
J64-6
J64-5
R221 150K 1W
C201 50µF
J62-4
+550V
CR101 -497
J64
C121B 150µF
R121 150K 2W
J62
+350V
J66
+175V
C121A 150µF
CR1015A -406
CR1015B
J73-2
+15V
R22 1.18K
R2 1K
VR2 6.2V
C2 4.7µF
U11 -067
C11 .002
C20 0.1
R20 6.2K
Q23 -302
Q24 -302
R25 100
R23 390
J75-1
J75-2
J75-3
Q1016 -337
R24 1.2Ω
C242 9600µF
F31 3A
CR31 -066
J69
+25 V
J68
CR32 -066
+15V
C131 15µF
TP68
R21 3.01K
R12 1K
R11 2.0K
+15 VOLTS
J73-3
CR1018 (PILOT LITE)
J60
CR201 -488
J61-1
J61-2
R222 680 1W
C222 6000µF
+5V (UNREG)
J67-9
J67-8
U1018 LM309K
J67-7
TP67
J67
+5V
C101 33µF
TP70
TP69
J74
-15V
CR52 -066
R52 1.2Ω
C141 15µF
Q62
R53 100
C62 .002
+15V
R65 10.0K
R64 10.0K
C61 .002
-15V
+5V
U64 -0067
R63 4.7K
R61 6.2K
C60 0.1
Q51 -134
J72-1
J72-2
J72-3
Q1020 -337
R54 390
F41 2A
J70-8
-25V
J70-7
CR41 -066
J70
TP42
J69-1
J73-1
CR1015C
CR1015D
C142 9600µF
VR42 27V
+5V (UNREG)
R41 100
+175V
R141 130K
Q42 -302
J69-4
+5V (UNREG)
J69-5
Q1022 -337
TP41
+1V
J69
TO FG HEATER ⑤
A5
S1015
S1014
F1014 3A (FAST)
J1014



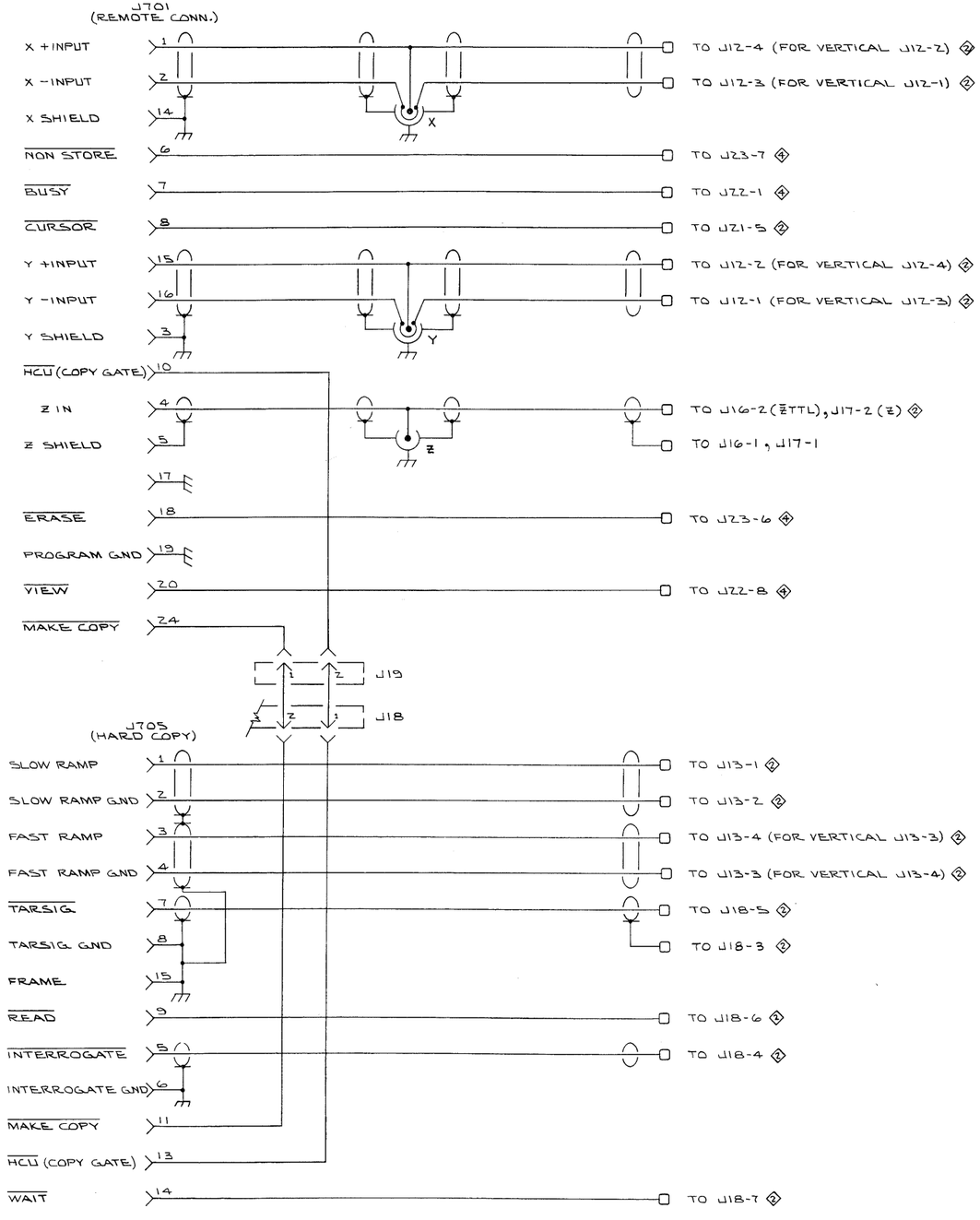
1407-55

A6 High Voltage and Z Axis board, 670-2308-00 and up.

REV. B, DEC. 1974



HIGH VOLTAGE & Z AXIS BOARD


J701
(REMOTE CONN.)
X +INPUT
X -INPUT
X SHIELD
NON STORE
BUSY
CURSOR
Y +INPUT
Y -INPUT
Y SHIELD
HCU (COPY GATE)
Z IN
Z SHIELD
ERASE
PROGRAM GND
VIEW
MAKE COPY
J19
J18
J705
(HARD COPY)
SLOW RAMP
SLOW RAMP GND
FAST RAMP
FAST RAMP GND
TARSIG
TARSIG GND
FRAME
READ
INTERROGATE
INTERROGATE GND
MAKE COPY
HCU (COPY GATE)
WAIT
TO J12-4 (FOR VERTICAL J12-2)
TO J12-3 (FOR VERTICAL J12-1)
TO J23-7
TO J22-1
TO J21-5
TO J12-2 (FOR VERTICAL J12-4)
TO J12-1 (FOR VERTICAL J12-3)
TO J16-2 (TTL), J17-2 (Z)
TO J16-1, J17-1
TO J23-6
TO J22-8
TO J13-1
TO J13-2
TO J13-4 (FOR VERTICAL J13-3)
TO J13-3 (FOR VERTICAL J13-4)
TO J18-5
TO J18-3
TO J18-6
TO J18-4
TO J18-7

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

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

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W/	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
00779	AMP, Inc.	P. O. Box 3608	Harrisburg, PA 17105
00866	Goe Engineering Co., Inc.	P. O. Box 3485	City of Industry, CA 91746
05820	Wakefield Engineering, Inc.	Audubon Road	Wakefield, MA 01880
06915	Richco Plastic Co.	5825 N. Tripp Ave.	Chicago, IL 60646
08261	Spectra-Strip Corp.	7100 Lampson Ave.	Garden Grove, CA 92642
12327	Freeway Corp.	9301 Allen Dr.	Cleveland, OH 44125
16428	Belden Corp.	P. O. Box 1101	Richmond, IN 47374
22526	Berg Electronics, Inc.	Youk Expressway	New Cumberland, PA 17070
26365	Gries Reproducer Co., Div. of Coats and Clark Inc.	125 Beechwood Ave.	New Rochelle, NY 10802
27193	Cutler-Hammer, Inc. Specialty Products Division	4201 N. 27th St.	Milwaukee, WI 53216
28520	Heyman Mfg. Co.	147 N. Michigan Ave.	Kenilworth, NJ 07033
70276	Allen Mfg. Co.	P. O. Drawer 570	Hartford, CT 06101
70485	Atlantic India Rubber Works, Inc.	571 W. Polk St.	Chicago, IL 60607
71400	Bussman Mfg., Division of McGraw-Edison Co.	2536 W. University St.	St. Louis, MO 63107
71468	ITT Cannon Electric	666 E. Dyer Rd.	Santa Ana, CA 92702
71590	Centralab Electronics, Div. of Globe-Union, Inc.	5757 N. Green Bay Ave.	Milwaukee, WI 53201
71785	TRW Electronic Components, Cinch Connector Operations	1501 Morse Ave.	Elk Grove Village, IL 60007
73743	Fischer Special Mfg. Co.	446 Morgan St.	Cincinnati, OH 45206
74445	Holo-Krome Co.	31 Brook St. West	Hartford, CT 06110
74921	Iten Fibre Co., The	4001 Benefit Ave.	Ashtabula, OH 44004
75497	Lamson and Sessions Co., The	5000 Tiedeman Road	Cleveland, OH 44144
75915	Littelfuse, Inc.	800 E. Northwest Hwy	Des Plaines, IL 60016
77250	Pheoll Manufacturing Co., Division of Allied Products Corp.	5700 W. Roosevelt Rd.	Chicago, IL 60650
78189	Illinois Tool Works, Inc. Shakeproof Division	St. Charles Road	Elgin, IL 60120
79807	Wrought Washer Mfg. Co.	2100 S. O Bay St.	Milwaukee, WI 53207
80009	Tektronix, Inc.	P. O. Box 500	Beaverton, OR 97077
81439	Therm-O-Disc, Inc.	1320 S. Main St.	Mansfield, OH 44907
83385	Central Screw Co.	2530 Crescent Dr.	Broadview, IL 60153
89663	Reese, J. Ramsey, Inc.	71 Murray St.	New York, NY 10007
91836	Kings Electronics Co., Inc.	40 Marbledale Road	Tuckahoe, NY 10707
95354	Methode Manufacturing Corp.	1700 So. Hicks Rd.	Rolling Meadows, IL 60008
95712	Bendix Corp., The Electrical Components Div., Microwave Devices Plant	Hurricane Road	Franklin, IN 46131
98410	ETC, Inc.	990 E. 67th Street	Cleveland, OH 44103
98978	International Electronic Research Corp.	135 W. Magnolia Ave.	Burbank, CA 91502

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-1	337-1706-03			1	SHLD,IMPLOSION:HORIZONTAL(613)	80009	337-1706-03
	337-1706-04			1	SHLD,IMPLOSION:VERTICAL(613-1)	80009	337-1706-04
					(ATTACHING PARTS)		
-2	211-0581-00			4	SCREW,MACHINE:6-32 X 0.375 INCH,TRH STL	83385	OBD
					- - - * - - -		
-3	426-0681-00			2	FR,PUSH BUTTON:GRAY PLASTIC	80009	426-0681-00
-4	----- -----			1	LAMP,LED:(SEE CR1018 EPL)		
-5	407-0997-00	XB010201		2	BRACKET,ANGLE:IMP SHIELD RET,9 INCH L	80009	407-0997-00
					(ATTACHING PARTS)		
-6	211-0065-00	XB010201		2	SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	77250	OBD
					- - - * - - -		
-7	337-1743-00	XB010201		1	SHIELD,ELEC:0.125THK X 8.30W X 10" H,DBL STR	80009	337-1743-00
-8	426-0834-00	B010100	B010200	1	FR,IMPLOSION SH:	80009	426-0834-00
	426-0834-01	B010201		1	FR,IMPLOSION SH:	80009	426-0834-01
					(ATTACHING PARTS)		
-9	210-0445-00			4	NUT,PLAIN HEX:10-32 X 0.375 INCH,STL	83385	OBD
-10	361-0541-00			4	SPACER,SLEEVE:0.50 OD X 0.976 INCH LONG	80009	361-0541-00
-11	344-0233-00	B010100	B010200X	4	CLIP,GROUND:CRT	80009	344-0233-00
					- - - * - - -		
-12	----- -----			1	ELECTRON TUBE:(SEE V1 EPL)		
-13	354-0316-01			1	. RING,CRT MTG:NEOPRENE	80009	354-0316-01
-14	131-1188-00			1	. CONN,PLUG,ELEC:7 PIN,MINIATURE	95354	MM-850
-15	131-1187-00			1	. SHLD,ELEC CONN:	95354	C-850-1V
	334-2104-00			1	MARKER,INDENT:WARNING	80009	334-2104-00
-16	386-2360-00			1	SUPPORT,CRT:HORIZONTAL(613)	80009	386-2360-00
	386-2367-00			1	SUPPORT,CRT:VERTICAL(613-1)	80009	386-2367-00
					(ATTACHING PARTS)		
	211-0504-00			6	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-17	337-1519-00			1	SHIELD,CRT:FRONT	80009	337-1519-00
					(ATTACHING PARTS)		
	211-0504-00			4	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-18	386-2350-00			2	SUPPORT,CRT:REAR	80009	386-2350-00
					(ATTACHING PARTS FOR EACH)		
	211-0504-00			4	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-19	255-0334-00			IN	PLASTIC CHANNEL:12.75 INCHES LONG	80009	255-0334-00
-20	337-1695-00			1	SHIELD,CRT:NECK	80009	337-1695-00
-21	----- -----			1	YOKE ASSY:(SEE L1001A,B EPL)		
-22	131-0621-00			4	. CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
-23	352-0200-00			1	HOLDER,TERM.CON:4 WIRE BLACK	80009	352-0200-00
					(ATTACHING PARTS)		
-24	212-0004-00			2	SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	OBD
-25	210-0458-00			2	NUT,PLAIN,EXT W:8-32 X 0344 INCH,STL	83385	OBD
					- - - * - - -		
-26	407-1222-00			1	BRKT,TUBE DEFL:BEAM ROTATOR	80009	407-1222-00
					(ATTACHING PARTS)		
-27	211-0504-00			4	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-28	407-1150-00			1	BRKT,CRT SHIELD:REAR	80009	407-1150-00
					(ATTACHING PARTS)		
-29	211-0504-00			2	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-30	352-0356-00			1	HOLDER,CRT RTNR:REAR	80009	352-0356-00
					(ATTACHING PARTS)		
-31	211-0542-00			2	SCREW,MACHINE:6-32 X 0.312 INCH,TRH STL	83385	OBD
					- - - * - - -		

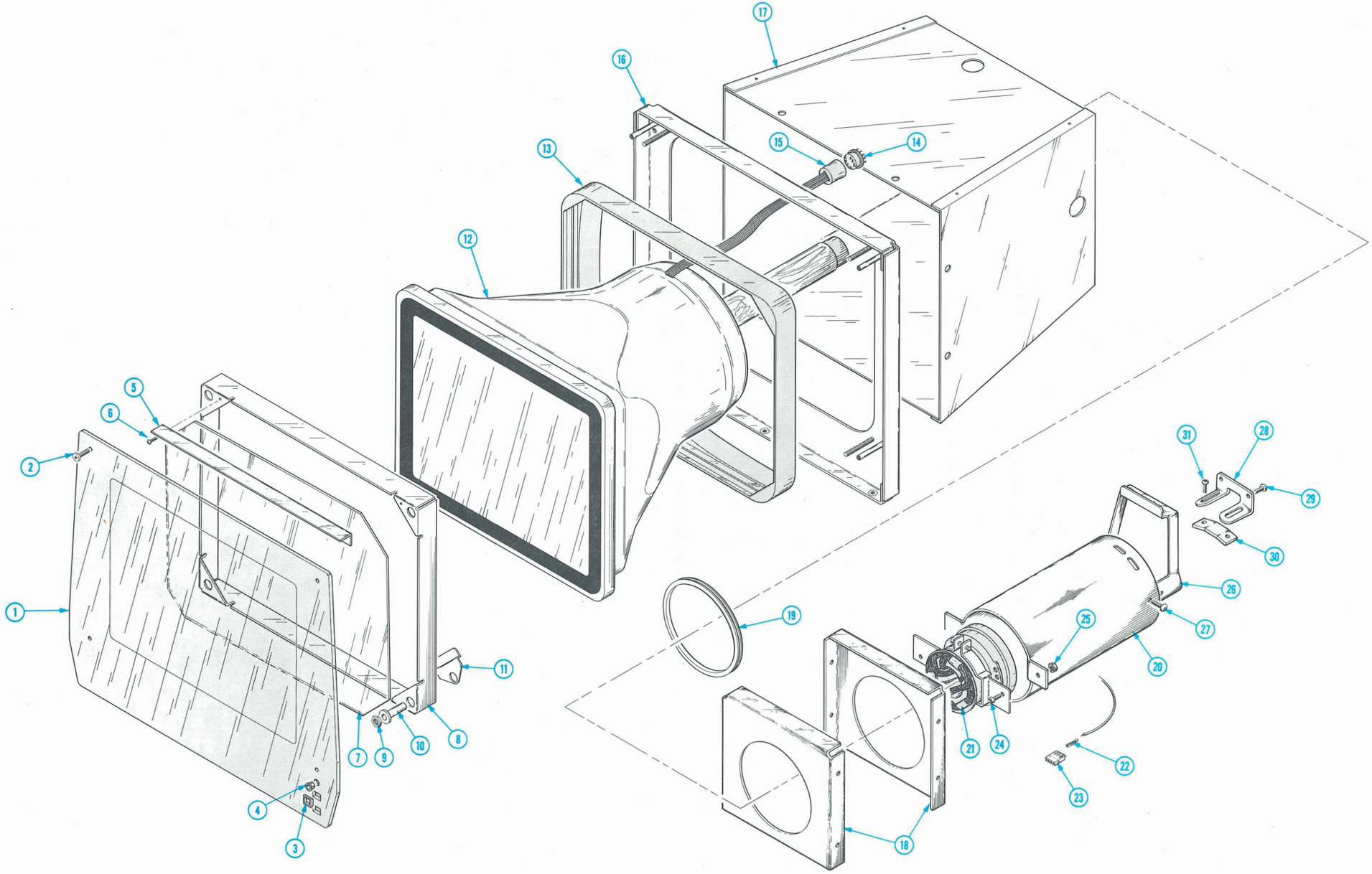

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FIG. 2 CHASSIS & CIRCUIT BOARDS

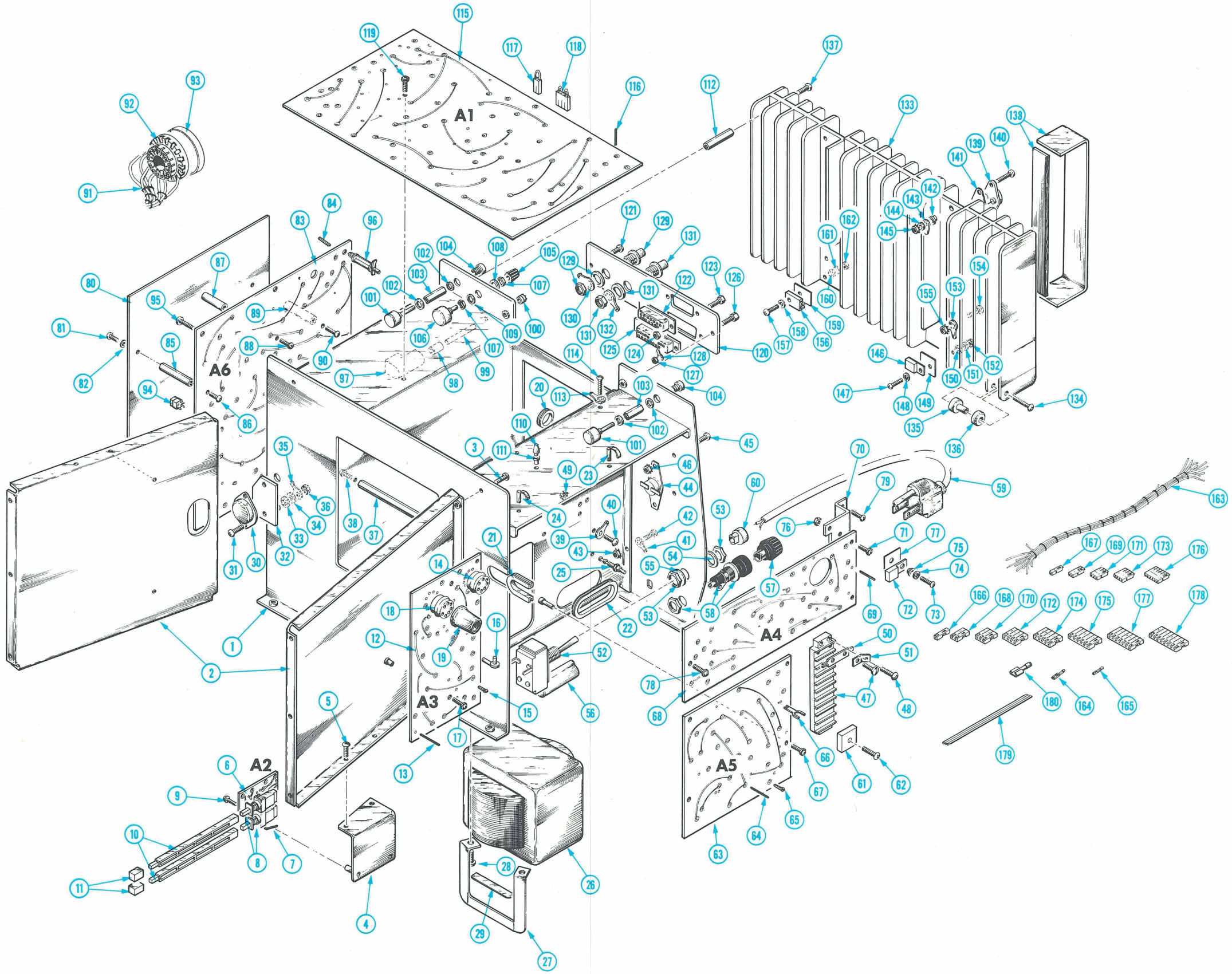

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-1	441-1100-00			1	CHAS,DSPL UNIT:	80009	441-1100-00
	352-0025-00	XB070000		1	FUSEHOLDER:	75915	357002
					(ATTACHING PARTS)		
	211-0510-00	XB070000		2	SCREW,MACHINE:6-32 X 0.375 INCH,PNH STL	83385	OBD
	210-0457-00	XB070000		2	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-2	441-1105-00			2	CHAS,DSPL UNIT:MONITOR	80009	441-1105-00
					(ATTACHING PARTS FOR EACH)		
-3	211-0504-00			6	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-4	407-1151-00			1	BRACKET,SWITCH:	80009	407-1151-00
					(ATTACHING PARTS)		
-5	211-0504-00			2	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-6	----- -----			1	CKT BOARD ASSY:SWITCH(SEE A2 EPL)		
-7	131-0589-00			3	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-8	260-1308-00			2	. SWITCH,PUSH:MOMENTARY	71590	2KAA010000-440
					(ATTACHING PARTS FOR CKT BD)		
-9	211-0116-00			2	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
					- - - * - - -		
-10	384-1101-00			2	EXTENSION SHAFT:4.14 INCH LONG	80009	384-1101-00
-11	366-1257-00			2	PUSH BUTTON:GRAY PLASTIC	80009	366-1257-00
-12	----- -----			1	CKT BOARD ASSY:HARD COPY(SEE A3 EPL)		
-13	131-0589-00			7	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
	131-0633-00			1	. CONTACT,ELEC:0.385 INCH LONG	80009	131-0633-00
	131-1233-00			7	. TERMINAL PIN:0.340 INCH LONG	80009	131-1233-00
-14	136-0058-00			1	. SKT,PL-IN ELEK:7 PIN	71785	111-51-11-014
-15	214-0579-00			5	. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
	210-1014-00			1	. WASHER,FLAT:0.094 ID X 0.312" OD,TEFLON	80009	210-1014-00
-16	352-0125-00			1	. HOLDER,TOROID:MOLD ACETAL	80009	352-0125-00
					(ATTACHING PARTS FOR CKT BD)		
-17	211-0116-00			2	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
					- - - * - - -		
-18	136-0271-00			1	SKT,PL-IN ELEK:7 PIN	71785	111-01-10-012
-19	200-0811-00			1	COVER,SKT TERM:	80009	200-0811-00
-20	348-0006-00			3	GROMMET,RUBBER:0.562 ID X 0.875 INCH OD	70485	1720
-21	348-0141-00			3	GROMMET,PLASTIC:U-SHP,0.625 X0.658 INCH	80009	348-0141-00
-22	252-0564-00			IN	PLASTIC EXTR:11.75 INCH LONG	80009	252-0564-00
-23	343-0089-00			5	CLAMP,LOOP:LARGE	80009	343-0089-00
-24	343-0088-00			4	CLAMP,LOOP:0.062 INCH DIA	80009	343-0088-00
-25	129-0006-00			1	TERMINAL,STUD:INSULATED	00866	1700P
-26	----- -----			1	TRANSFORMER:(SEE T1015 EPL)		
-27	407-1174-00			2	BRACKET,XFMR:	80009	407-1174-00
					(ATTACHING PARTS)		
-28	212-0004-00			2	SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-29	342-0028-00			2	INSULATOR,PLATE:0.600 W X 1.700 INCH LONG	80009	342-0028-00
-30	----- -----			1	TRANSISTOR:(SEE Q1026 EPL)		
					(ATTACHING PARTS)		
-31	211-0513-00			2	SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
-32	214-1610-00			1	HEAT SINK,ELEC:TRANSISTOR	80009	214-1610-00
-33	210-0967-00			2	WSHR,SHOULDERED:0.157 ID X 0.375 INCH OD	80009	210-0967-00
-34	210-0803-00			2	WASHER,FLAT:0.15 ID X 0.375 INCH OD,STL	12327	OBD
-35	210-0202-00			1	TERMINAL,LUG:SE #6	78189	2104-06-00-2520N
-36	210-0457-00			2	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-37	129-0405-00			1	SPACER,POST:HEX,0.250 X 5.781 INCH LONG	80009	129-0405-00
					(ATTACHING PARTS)		
-38	211-0504-00			1	SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-39	210-0201-00			1	TERMINAL,LUG:SE #4	78189	2104-04-00-2520N
					(ATTACHING PARTS)		
-40	213-0044-00			1	SCR,TPG,THD FOR:5-32 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-41	210-0205-00			1	TERMINAL,LUG:SE #8	78189	2104-08-00-2520N
					(ATTACHING PARTS)		
-42	212-0004-00			1	SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL	83385	OBD
-43	210-0458-00			1	NUT,PLAIN,EXT W:8-32 X 0344 INCH,STL	83385	OBD
					- - - * - - -		
-44	260-0551-00			1	SWITCH,THRMSTC:NC,10A,240VAC	81439	36T2L SN3780
					(ATTACHING PARTS)		
-45	211-0008-00			2	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-46	210-0586-00			2	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
-47	124-0006-00	B010100	B029999	1	TERMINAL BOARD:	71785	353-19-08-168
					(ATTACHING PARTS)		
-48	211-0513-00			2	SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
-49	210-0457-00			2	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-50	210-0292-00	B010100	B029999	10	TERMINAL,LUG:	98410	3701
-51	131-1247-00	B010100	B029999	9	TERM,QIK DISC:	00779	61664-1
	124-0282-00	B030000		1	TERM STRIP,GND:ASSEMBLY	98410	37008-SPL
	210-0292-00	B030000		10	. TERMINAL,LUG:	98410	3901
	131-1247-00	B030000		9	. TERM,QIK DISC:	00779	61664-1
-52	260-1102-00	B010100	B070579	1	SWITCH,TOGGLE:DPST,15A,125VAC	27193	8906K-1667
	260-1060-01	B070580		1	SWITCH,LEVER:DPST,15A,125VAC	27193	8906K-1640
					(ATTACHING PARTS)		
-53	210-0414-00			2	NUT,PLAIN,HEX.:0.468-32 X 0.562 INCH,BRS	73743	3167-402
-54	210-0845-00			1	WASHER,FLAT:0.500 ID X 0.625 INCH OD,STL	89663	634R
-55	210-0021-00			1	WASHER,LOCK:INTL,0.476 ID X 0.60"OD STL	78189	1222-01-00-0541C
					- - - * - - -		
-56	200-0237-00			1	INS HOOD,INS:FUSEHOLDER	80009	200-0237-00
-57	200-0582-00			1	CAP,FUSEHOLDER:	71400	9435 1-2
-58	352-0010-00			1	FUSEHOLDER:WITH HARDWARE	71400	HKPL
-59	161-0033-07			1	CABLE ASSY,PWR,:3 WIRE,92 INCH LONG	16428	KH8002
					(ATTACHING PARTS)		
-60	358-0161-00			1	BSHG,STRAIN RLF:FOR 0.50 INCH HOLE,PLASTIC	28520	SR5P4
					- - - * - - -		
-61	----- -----			1	DIODE:		
					(ATTACHING PARTS)		
-62	211-0581-00			1	SCREW,MACHINE:6-32 X 0.375 INCH,TRH STL	83385	OBD
					- - - * - - -		
-63	----- -----			1	CKT BOARD ASSY:POWER SUPPLY(SEE A5 EPL)		
-64	131-0589-00			63	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-65	214-0579-00			6	. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-66	344-0154-00			4	. CLIP,ELECTRICAL:FOR 0.25 INCH DIA FUSE	80009	344-0154-00
					(ATTACHING PARTS FOR CKT BD)		
-67	211-0116-00			5	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
					- - - * - - -		
-68	----- -----			1	CKT BOARD ASSY:STORAGE(SEE A4 EPL)		
-69	131-0608-00			27	. CONTACT,ELEC:0.365 INCH LONG	22526	47357
	214-1292-00	B010100	B069999	1	. HEAT SINK,ELEC:TRANSISTOR	05820	205-AB
	214-0269-00	B070000		1	. HEAT SINK,ELEC:5INCH LONG	98978	TDX032-075
-70	214-1789-00			1	. HEAT SINK,XSTR:	80009	214-1789-00
					(ATTACHING PARTS)		
-71	211-0008-00			2	. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-72	----- -----			3	. TRANSISTOR:(SEE A4-Q53,Q153,Q253 EPL)		
					(ATTACHING PARTS FOR EACH)		
-73	211-0507-00			1	. SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
-74	210-0967-00			1	. WSHR,SHOULDERED:0.157 ID X 0.375 INCH OD	80009	210-0967-00
-75	210-0803-00			1	. WASHER,FLAT:0.15 ID X 0.375 INCH OD,STL	12327	OBD
-76	210-0457-00			1	. NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
-77	342-0163-00			1	. INSULATOR,PLATE:XSTR,0.675 X 0.625 X 0.001"	80009	342-0163-00
					- - - * - - -		
					(ATTACHING PARTS FOR CKT BD)		
-78	211-0116-00			1	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
-79	211-0008-00			3	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-80	337-1741-00			1	SHIELD,ELEC:HIGH VOLTAGE	80009	337-1741-00
					(ATTACHING PARTS)		
-81	211-0065-00			2	SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	77250	OBD
-82	210-0004-00			1	WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL	78189	1204-00-00-0541C
					- - - * - - -		
-83	----- -----			1	CKT BOARD ASSY:HIGH VOLTAGE(SEE A6 EPL)		
-84	131-0589-00			21	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-85	384-0616-00			1	. SPACER,POST:HEX,0.25 X 1.370 INCH LONG	80009	384-0616-00
					(ATTACHING PARTS)		
-86	211-0008-00			1	. SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-87	385-0135-00			1	. INS,STANDOFF:0.312 OD X 0.938 INCH LONG	80009	385-0135-00
					(ATTACHING PARTS)		
-88	213-0054-00			1	. SCR,TPG,THD FOR:6-32 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
-89	129-0178-00			1	. SPACER,POST:0.312 OD X 1.365 INCH LONG	80009	129-0178-00
					(ATTACHING PARTS)		
-90	211-0040-00			1	. SCREW,MACHINE:4-40 X 0.25",BDCH PLSTC	26365	921112
					- - - * - - -		
	214-0579-00			1	. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-91	136-0518-00			1	. SKT,PL-IN ELEK:ASSEMBLY	80009	136-0518-00
-92	136-0278-00			1	. . SOCKET,PLUG-IN:WITH PINS	80009	136-0278-00
-93	200-0801-00			1	. . COVER,SOCKET,PL:ELECTRON TUBE,PLASTIC	80009	200-0801-00
	214-1292-00			2	. HEAT SINK,ELEC:TRANSISTOR	05820	205-AB
	124-0050-00			1	. PLASTIC STRIP:0.75W X 9.875"L,FOAM TAPE	80009	124-0050-00
-94	136-0183-00			1	. SOCKET,PLUG-IN:3 PIN	80009	136-0183-00
					(ATTACHING PARTS FOR CKT BD)		
-95	211-0116-00			2	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
					- - - * - - -		
-96	386-2071-00			3	SUPPORT,CKT BD:0.875 INCH LONG	06915	CBS-14R
-97	200-1327-00			1	SHIELD,RESISTOR:	80009	200-1327-00
-98	376-0029-00			1	CPLG,SHAFT,RGD:0.128 ID X 0.312 OD X 0.5"L	80009	376-0029-00
	213-0075-00			2	. SETSCREW:4-40 X 0.094 INCH,HEX SOC STL	70276	OBD
-99	384-1181-00			1	EXTENSION SHAFT:1.840 INCH LONG	80009	384-1181-00
-100	366-0261-00			1	KNOB:0.312 OD X 0.406 INCH LONG	80009	366-0261-00
-101	----- -----			2	RESISTOR,VAR:(SEE R1010,R1030 EPL)		
					(ATTACHING PARTS FOR EACH)		
-102	210-0046-00			2	WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
-103	210-0471-00			1	NUT,SLEEVE:HEX.,0.312 X 0.594 INCH LONG	80009	210-0471-00
-104	358-0054-00			1	BSHG,MACH THD:0.406 INCH LONG	80009	358-0054-00
					- - - * - - -		
-105	366-1023-00			1	KNOB:GRAY	80009	366-1023-00
	213-0153-00			1	. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-106	----- -----			1	RESISTOR,VAR:(SEE R1028 EPL)		
					(ATTACHING PARTS)		
-107	210-0583-00			2	NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20319-402
-108	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
-109	210-0046-00			1	WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
					- - - * - - -		
-110	361-0007-00			4	SPACER,SLEEVE:0.250 INCH DIA,PLASTIC	80009	361-0007-00
-111	105-0065-00			4	SUPPORT,CKT BD:0.25 OD X 0.670 INCH LONG	80009	105-0065-00
-112	385-0122-00			2	SPACER,POST:HEX,0.25 X 0.937 INCH LONG	80009	385-0122-00
-113	210-0201-00			1	TERMINAL,LUG:SE #4	78189	2104-04-00-2520N
					(ATTACHING PARTS)		
-114	211-0008-00			1	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
	210-0586-00			1	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
-115	----- -----			1	CKT BOARD ASSY:DEFLECTION AMPL(SEE A1 EPL)		
	214-0579-00	XB050000		10	. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-116	131-0589-00	B010100	B049999	100	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
	131-0589-00	B050000		103	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
-117	131-1334-00	B010100	B049999	6	. LINK,TERM CONN:	80009	131-1334-00
	131-1334-00	B050000		7	. LINK,TERM CONN:	80009	131-1334-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-	131-0621-00			2	. . CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
	352-0198-00			1	. . HOLDER,TERM.CON:2 WIRE BLACK	80009	352-0198-00
-118	131-1350-00			1	. LINK,TERM CONN:	80009	131-1350-00
	131-0621-00			4	. . CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
	352-0201-00			1	. . HOLDER,TERM.CON:5 WIRE BLACK	80009	352-0201-00
					(ATTACHING PARTS FOR CKT BD)		
-119	211-0116-00			2	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
	337-2240-00			1	SHIELD,PROT:CABLE	80009	337-2240-00
					- - - * - - -		
	----- -----	XB020000	B049999X	1	CKT BOARD ASSY:ORIGIN SHIFTER(SEE A1A EPL)		
	214-0579-00			1	. TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
	175-0861-00			IN	. CABLE,SP ELEC:4 WIRE RIBBON,20.5 INCH L	80009	175-0861-00
	352-0220-00			1	. HOLDER,MODULE:	80009	352-0220-00
	131-0589-00			7	. CONTACT,ELEC:0.46 INCH LONG	22526	47350
	131-0621-00			7	. CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
	131-1334-00			1	. LINK,TERM CONN:	80009	131-1334-00
	105-0065-00			1	. SUPPORT,CKT BD:0.25 OD X 0.670 INCH L	80009	105-0065-00
	361-0041-00			1	. POST,ELEC-MECH:4-40 X 0.25 X0.375 INCH L	80009	361-0041-00
	361-0007-00			1	. SPACER,SLEEVE:0.250 INCH DIA,PLASTIC	80009	361-0007-00
	211-0017-00			1	. SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
	210-0938-00			1	. WASHER,FLAT:0.109 ID X 0.25 INCH OD,STL	75497	AN960-3
	210-0811-00			1	. WASH.,SHOULDERE:0.125 ID X 0.50 INCH OD	74921	6525
	210-0054-00			1	. WASHER,LOCK:SPLIT,0.118 ID X 0.212"OD STL	83385	OBD
-120	386-2365-00			1	PLATE,CONN MTG:0.150 W X 6.186 INCH LONG	80009	386-2365-00
					(ATTACHING PARTS)		
-121	211-0581-00			2	SCREW,MACHINE:6-32 X 0.375 INCH,TRH STL	83385	OBD
					- - - * - - -		
-122	131-0458-00			1	CONNECTOR,RCPT,:15 PIN,FEMALE	71468	DA15S
					(ATTACHING PARTS)		
-123	129-0260-00			2	POST,ELEC-MECH:0.187 OD X 0.39 INCH L	80009	129-0260-00
-124	210-0586-00			2	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
-125	131-0569-00			1	CONNECTOR,RCPT,:25 PIN,FEMALE	71468	DB25S
					(ATTACHING PARTS)		
-126	129-0260-00			2	POST,ELEC-MECH:0.187 OD X 0.39 INCH L	80009	129-0260-00
-127	210-0586-00			2	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
-128	210-0201-00			1	TERMINAL,LUG:SE #4	78189	2104-04-00-2520N
					- - - * - - -		
-129	131-0126-00			1	CONNECTOR,RCPT,:BNC,FEMALE	95712	9663-INT34
					(ATTACHING PARTS)		
-130	210-0241-00			1	TERMINAL,LUG:0.515 ID X 0.625 INCH OD SE	80009	210-0241-00
					- - - * - - -		
-131	131-0274-00			2	CONNECTOR,RCPT,:BNC	91836	KC79-67
					(ATTACHING PARTS FOR EACH)		
-132	210-0241-00			1	TERMINAL,LUG:0.515 ID X 0.625 INCH OD SE	80009	210-0241-00
					- - - * - - -		
-133	214-1766-00			1	HEAT SINK,XSTR:POWER SUPPLY	80009	214-1766-00
					(ATTACHING PARTS)		
-134	211-0514-00			2	SCREW,MACHINE:6-32 X 0.750 INCH,PNH STL	83385	OBD
-135	361-0530-00			2	SPACER,SLEEVE:STEPPED,0.50 OD X 0.40 INCH L	80009	361-0530-00
-136	361-0531-00			2	SPACER,SLEEVE:0.50 OD X 0.165 INCH LONG	80009	361-0531-00
-137	211-0581-00			2	SCREW,MACHINE:6-32 X 0.375 INCH,TRH STL	83385	OBD
					- - - * - - -		
-138	200-1398-00			2	COVER,XSTR:WITH STRIPPING	80009	200-1398-00
-139	----- -----			3	TRANSITOR:(SEE Q1016,1020,1022 EPL)		
	----- -----			1	MICROCIRCUIT,LI:(SEE U1018 EPL)		
					(ATTACHING PARTS FOR EACH)		
-140	211-0513-00			2	SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
-141	386-0978-00			1	INSULATOR,PLATE:0.002 INCH MICA,FOR TO-3	80009	386-0978-00
-142	210-0967-00			2	WSHR,SHOULDERED:0.157 ID X 0.375 INCH OD	80009	210-0967-00
-143	210-0202-00			1	TERMINAL,LUG:SE #6	78189	2104-06-00-2520N
-144	210-0803-00			2	WASHER,FLAT:0.15 ID X 0.375 INCH OD,STL	12327	OBD
-145	210-0457-00			2	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-146	----- -----			2	TRANSISTOR:(SEE Q1010,Q1012 EPL)		
					(ATTACHING PARTS FOR EACH)		
-147	211-0016-00			1	SCREW,MACHINE:4-40 X 0.625 INCH,PNH STL	83385	OBD
-148	210-0071-00			1	WASHER,SPR TNSN:0.146 ID X 0.323" OD,STL	78189	4706-05-01-0531
-149	342-0163-00			1	INSULATOR,PLATE:XSTR,0.675 X 0.625 X 0.001"	80009	342-0163-00
-150	210-0811-00			1	WASH.,SHOULDERE:0.125 ID X 0.50 INCH OD	74921	6525
-151	210-0994-00			1	WASHER,FLAT:0.125 ID X 0.25" OD,STL	83385	OBD
-152	210-0586-00			1	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
-153	210-0202-00			1	TERMINAL,LUG:SE #6	78189	2104-06-00-2520N
					(ATTACHING PARTS)		
-154	211-0581-00			1	SCREW,MACHINE:6-32 X 0.375 INCH,TRH STL	83385	OBD
-155	210-0457-00			1	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-156	----- -----			4	TRANSISTOR:(SEE Q1002,1004,1006,1008 EPL)		
					(ATTACHING PARTS FOR EACH)		
-157	211-0016-00			1	SCREW,MACHINE:4-40 X 0.625 INCH,PNH STL	83385	OBD
-158	210-0071-00			1	WASHER,SPR TNSN:0.146 ID X 0.323" OD,STL	78189	4706-05-01-0531
-159	342-0163-00			1	INSULATOR,PLATE:XSTR,0.675 X 0.625 X 0.001"	80009	342-0163-00
-160	210-0811-00			1	WASH.,SHOULDERE:0.125 ID X 0.50 INCH OD	74921	6525
-161	210-0994-00			1	WASHER,FLAT:0.125 ID X 0.25" OD,STL	83385	OBD
-162	210-0586-00			1	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	OBD
					- - - * - - -		
-163	179-1874-00	B010100	B069999	1	WIRING HARNESS:CHASSIS	80009	179-1874-00
	179-1874-01	B070000		1	WIRING HARNESS:CHASSIS	80009	179-1874-01
-164	131-0621-00			80	. CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
	131-0622-00			9	. CONTACT,ELEC:0.577"L,28-32 AWG WIRE	22526	46241
-165	131-0707-00			24	. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
	131-0792-00			7	. CONTACT,ELEC:0.577"L,18-20AWG WIRE	22526	46221
-166	352-0197-00			1	. HOLDER,TERM.CON:1 WIRE BLACK	80009	352-0197-00
-167	352-0171-00			2	. HOLDER,TERM.CON:1 WIRE BLACK	80009	352-0171-00
-168	352-0198-00			10	. HOLDER,TERM.CON:2 WIRE BLACK	80009	352-0198-00
-169	352-0169-00			1	. HOLDER,TERM.CON:2 WIRE BLACK	80009	352-0169-00
-170	352-0199-00			3	. HOLDER,TERM.CON:3 WIRE BLACK	80009	352-0199-00
-171	352-0161-00			2	. HOLDER,TERM.CON:3 WIRE BLACK	80009	352-0161-00
-172	352-0200-00			3	. HOLDER,TERM.CON:4 WIRE BLACK	80009	352-0200-00
-173	352-0162-00			2	. HOLDER,TERM.CON:4 WIRE BLACK	80009	352-0162-00
-174	352-0201-00			2	. HOLDER,TERM.CON:5 WIRE BLACK	80009	352-0201-00
-175	352-0202-00			3	. HOLDER,TERM.CON:6 WIRE BLACK	80009	352-0202-00
-176	352-0164-00			1	. HOLDER,TERM.CON:6 WIRE BLACK	80009	352-0164-00
-177	352-0203-00			3	. HOLDER,TERM.CON:7 WIRE BLACK	80009	352-0203-00
-178	352-0204-00			2	. HOLDER,TERM.CON:8 WIRE BLACK	80009	352-0204-00
	179-1875-00			1	WIRING HARNESS:HEAT SINK	80009	179-1875-00
	131-0707-00			6	. CONTACT,ELEC:0.48"L,22-26 AWG WIRE	22526	47439
	131-0621-00			24	. CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
	352-0199-00			4	. HOLDER,TERM.CON:3 WIRE BLACK	80009	352-0199-00
	352-0161-00			2	. HOLDER,TERM.CON:3 WIRE BLACK	80009	352-0161-00
	352-0202-00			2	. HOLDER,TERM.CON:6 WIRE BLACK	80009	352-0202-00
	179-1876-00			1	WIRING HARNESS:HARD COPY	80009	179-1876-00
	131-0621-00			8	. CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
	131-0622-00			2	. CONTACT,ELEC:0.577"L,28-32 AWG WIRE	22526	46241
	131-0792-00			1	. CONTACT,ELEC:0.577"L,18-20AWG WIRE	22526	46221
-179	175-0826-00			FT	WIRE,ELECTRICAL:3 WIRE RIBBON	08261	TEK-175-0826-00
	175-0862-00			FT	CABLE,SP,ELEC:3 WIRE RIBBON,0.729 FT L	80009	175-0862-00
-180	131-0861-00			4	CONTACT,ELEC:QUICK DISCONNECT	00779	42617-2
	131-0621-00			8	CONTACT,ELEC:0.577"L,22-26 AWG WIRE	22526	46231
	352-0199-00			2	HOLDER,TERM.CON:3 WIRE BLACK	80009	352-0199-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
3-1	390-0298-01			1	COVER,SCOPE:TOP	80009	390-0298-01
					(ATTACHING PARTS)		
-2	212-0111-00			6	SCREW,MACHINE:8-32 X 0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-3	334-1555-00			4	PLATE,IDENT:TRADEMARK	80009	334-1555-00
-4	426-0928-00			4	FRAME,TRIM:GRAY PLASTIC	80009	426-0928-00
					(ATTACHING PARTS FOR EACH)		
-5	213-0088-00			1	SCR,TPG,THD CTG:4-24 X0.25 INCH,PNH STL	83385	OBD
					- - - * - - -		
-6	390-0296-01			1	COVER,SCOPE:BOTTOM	80009	390-0296-01
					(ATTACHING PARTS)		
	211-0507-00			11	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
	210-0005-00			3	WASHER,LOCK:EXT #6	78189	1106-00-00-0541C
					- - - * - - -		
-7	348-0128-00			4	BUMPER,PLASTIC:CABINET MTG,2.022 INCH LONG	80009	348-0128-00
					(ATTACHING PARTS)		
-8	211-0513-00			2	SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
					- - - * - - -		
					ACCESSORIES		
	337-1743-00			1	EMI SHIELD:	80009	337-1743-00
	070-1407-01			1	MANUAL,INTRUCTION:	80009	070-1407-01

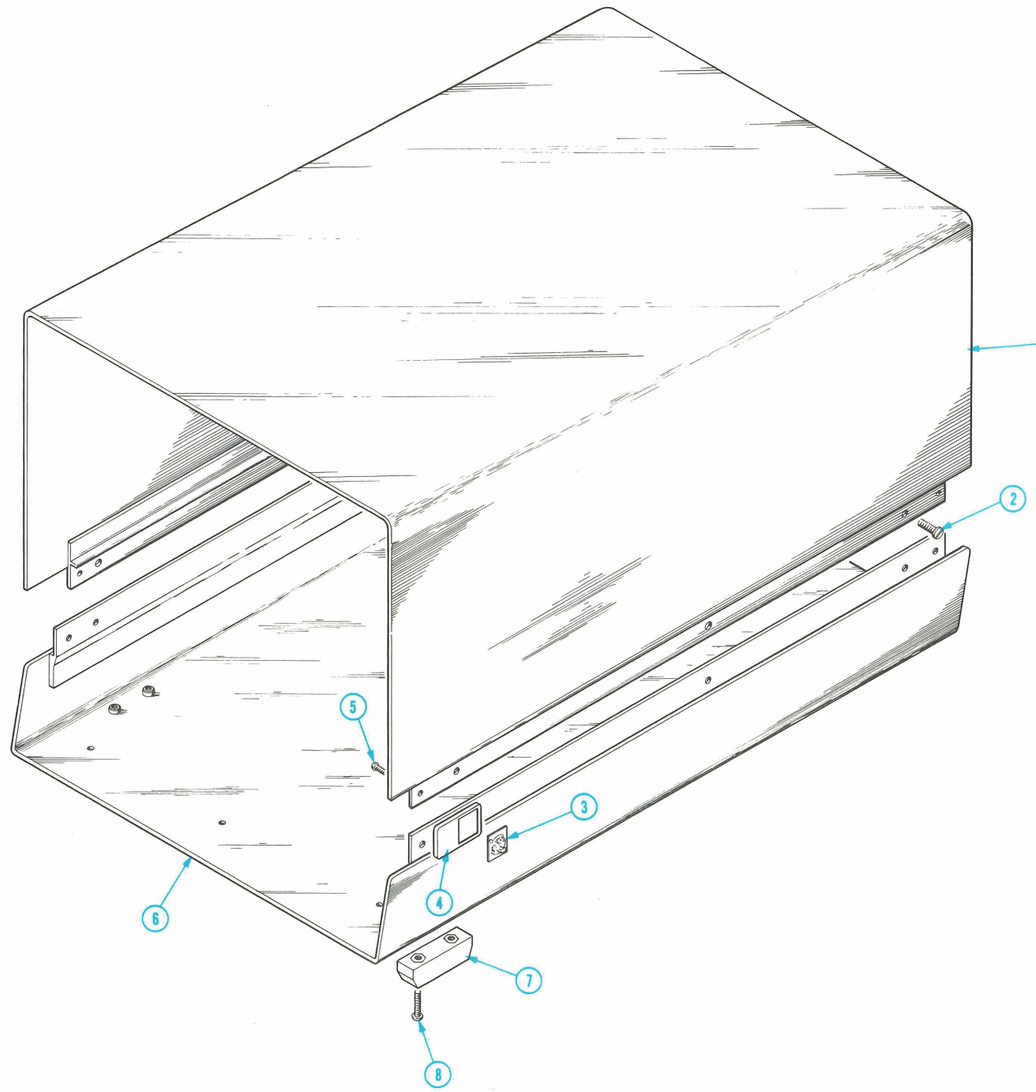

FIG. 3 CABINET

FIG. 4 REPACKAGING

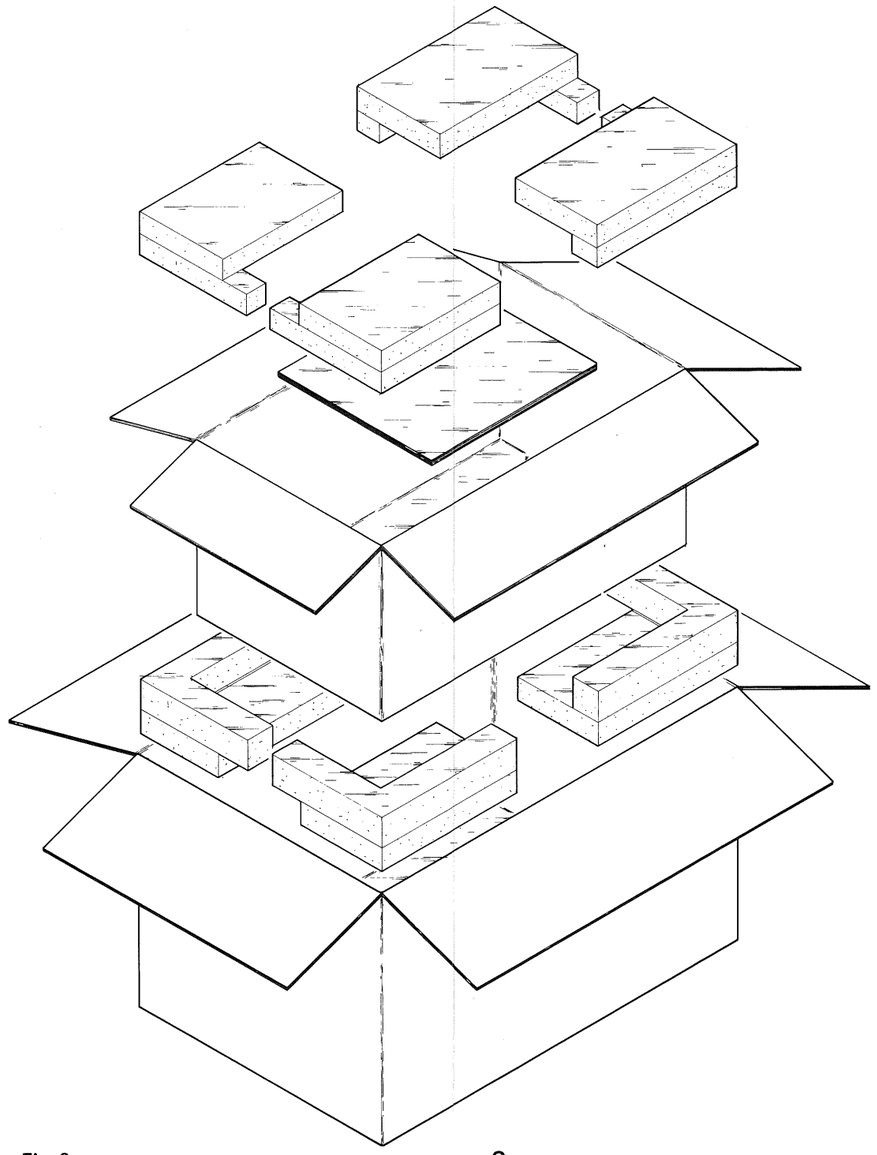

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5	Description
4-	065-0191-00			1		CARTON ASSEMBLY

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.

SERVICE NOTE

Because of the universal parts procurement problem, some electrical parts in your instrument may be different from those described in the Replaceable Electrical Parts List. The parts used will in no way alter or compromise the performance or reliability of this instrument. They are installed when necessary to ensure prompt delivery to the customer. Order replacement parts from the Replaceable Electrical Parts List.

CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

This chart compares TM 500 product performance to that of older Tektronix equipment. Only those characteristics where significant specification differences occur, are listed. In some cases the new instrument may not be a total functional replacement. Additional support instrumentation may be needed or a change in calibration procedure may be necessary.

Comparison of Main Characteristics

DM 501 replaces 7D13		
PG 501 replaces 107	PG 501 - Risetime less than 3.5 nsec into 50 Ω.	107 - Risetime less than 3.0 nsec into 50 Ω.
108	PG 501 - 5 V output pulse; 3.5 nsec Risetime.	108 - 10 V output pulse; 1 nsec Risetime.
111	PG 501 - Risetime less than 3.5 nsec; 8 nsec Pretrigger pulse delay.	111 - Risetime 0.5 nsec; 30 to 250 nsec Pretrigger Pulse delay.
114	PG 501 - ±5 V output.	114 - ±10 V output. Short proof output.
115	PG 501 - Does not have Paired, Burst, Gated, Delayed & Undelayed pulse mode; ±5 V dc Offset; short proof output. Has ±5 V output.	115 - Paired, Burst, Gated, Delayed & Undelayed pulse mode; ±10 V output. Short proof output.
PG 502 replaces 107		
108	PG 502 - 5 V output	108 - 10 V output.
111	PG 502 - Risetime less than 1 nsec; 10 nsec Pretrigger pulse delay.	111 - Risetime 0.5 nsec; 30 to 250 nsec Pretrigger pulse delay.
114	PG 502 - ±5 V output.	114 - ±10 V output. Short proof output.
115	PG 502 - Does not have Paired, Burst, Gated, Delayed & Undelayed pulse mode; ±5 V output. Short proof output.	115 - Paired, Burst, Gated, Delayed & Undelayed pulse mode; ±10 V output. Short proof output.
2101	PG 502 - Does not have Paired, Delayed, Undelayed and output locked mode; ±5 V output.	2101 - Paired, Delayed, Undelayed and output locked on mode; 10 V output.
PG 506 replaces 106	PG 506 - Positive-going trigger output signal at least 1 V; High Amplitude, 60 V output.	106 - Positive and Negative-going trigger output signal, 50 nsec and 1 V; High Amplitude output, 100 V.
067-0502-01	PG 506 - Does not have chopped feature.	0502-01 - Comparator output can be alternately chopped to a reference voltage.
SG 503 replaces 190, 190A, 190B	SG 503 - Amplitude range 5 mV to 5.5 V p-p.	190B - Amplitude range 40 mV to 10 V p-p.
191	SG 503 - Frequency range 250 kHz to 250 MHz.	191 - Frequency range 350 kHz to 100 MHz.
067-0532-01	SG 503 - Frequency range 250 kHz to 250 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
TG 501 replaces 180, 180A	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available only at 5,2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. Only one time-mark can be generated.	180A - Marker outputs, 5 sec to 1 μs. Sinewave available at 5, 10, and 50 MHz. Trigger pulses 1, 10, 100 Hz; 1,10, and 100 kHz. Multiple time-marks can be stacked.
181	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available only at 5, 2, and 1 ns.	181 - Marker outputs, 1, 10, 100, 1000, and 10,000, plus 10 MHz sinewave.
2901	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available only at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. Only one time-mark can be generated.	2901 - Marker outputs, 5 sec to 0.1 μs. Sinewave available at 5, 10, and 50 ns. Separate trigger pulses, from 5 sec to 0.1 μs. Multiple time-marks can be stacked.

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