Tektronix®

COMMITTED TO EXCELLENCE

## WARNING

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

**PLEASE CHECK FOR CHANGE INFORMATION AT THE REAR OF THIS MANUAL.**



# 5B25N
## DIGITIZER
## TIME BASE/AMPLIFIER
WITH OPTIONS
**SERVICE**



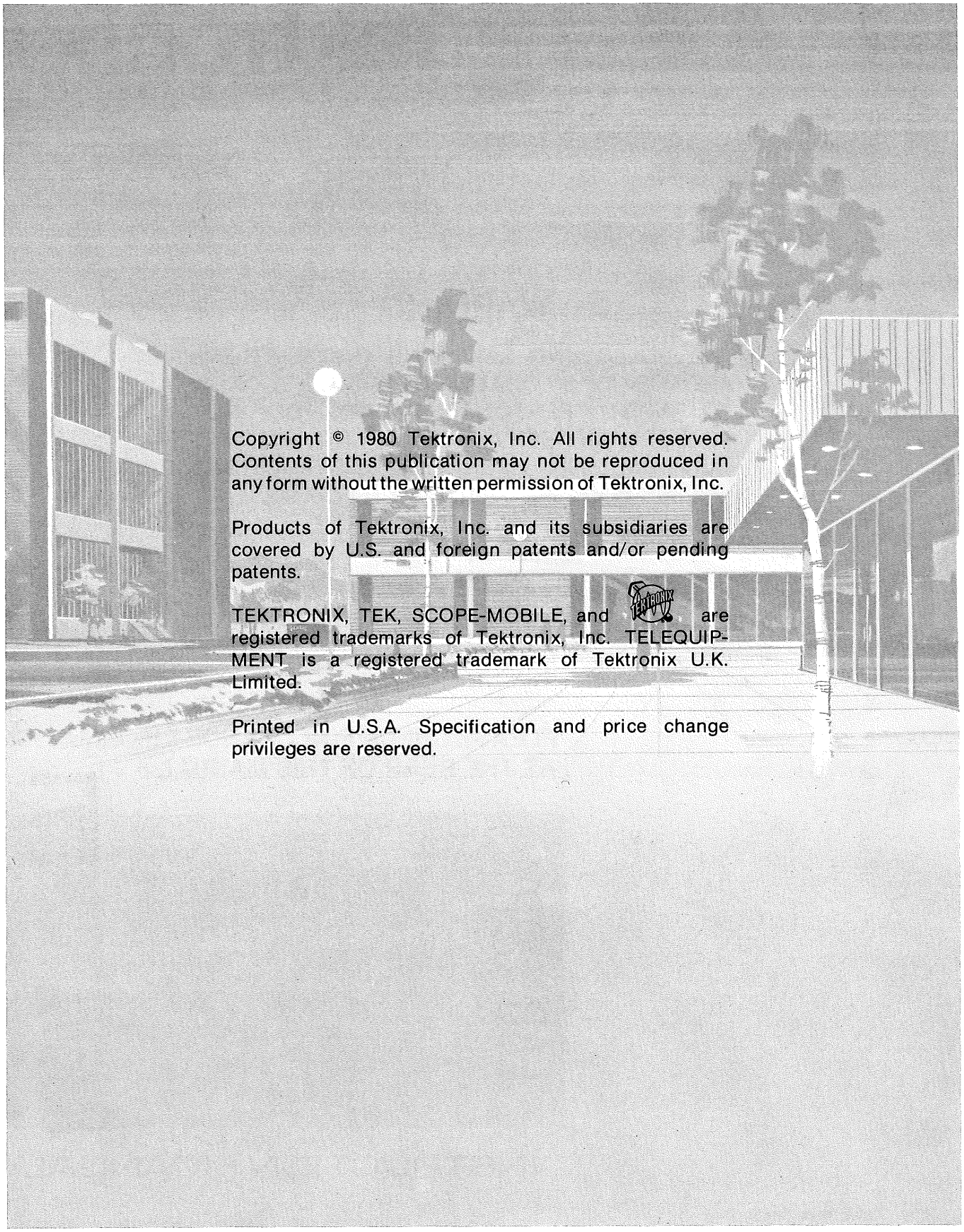
INSTRUCTION MANUAL

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

070-2813-00
Product Group 52

Serial Number _____

First Printing JUN 1980
Revised JAN 1982





Printed in U.S.A. Specification and price change privileges are reserved.

# TABLE OF CONTENTS

# TABLE OF CONTENTS (CONT)



# LIST OF ILLUSTRATIONS

# LIST OF ILLUSTRATIONS (CONT)



**The illustrations in section 8 are located near their associated diagrams on the foldout page.**



# LIST OF TABLES

# SAFETY SUMMARY

The general safety information contained in this summary is for servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

## TERMS

### IN THIS MANUAL

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

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

### AS MARKED ON EQUIPMENT

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

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

## SYMBOLS

### IN THIS MANUAL


Static-Sensitive Devices.


This symbol indicates where applicable cautionary or other information is to be found.

### AS MARKED ON EQUIPMENT


DANGER—High voltage.


Protective ground (earth) terminal.


ATTENTION—refer to manual.

## WARNINGS

### POWER SOURCE

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

### GROUNDING THE PRODUCT

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



@

## DANGER ARISING FROM LOSS OF GROUND

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

## DO NOT SERVICE ALONE

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

## USE CARE WHEN SERVICING WITH POWER ON

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

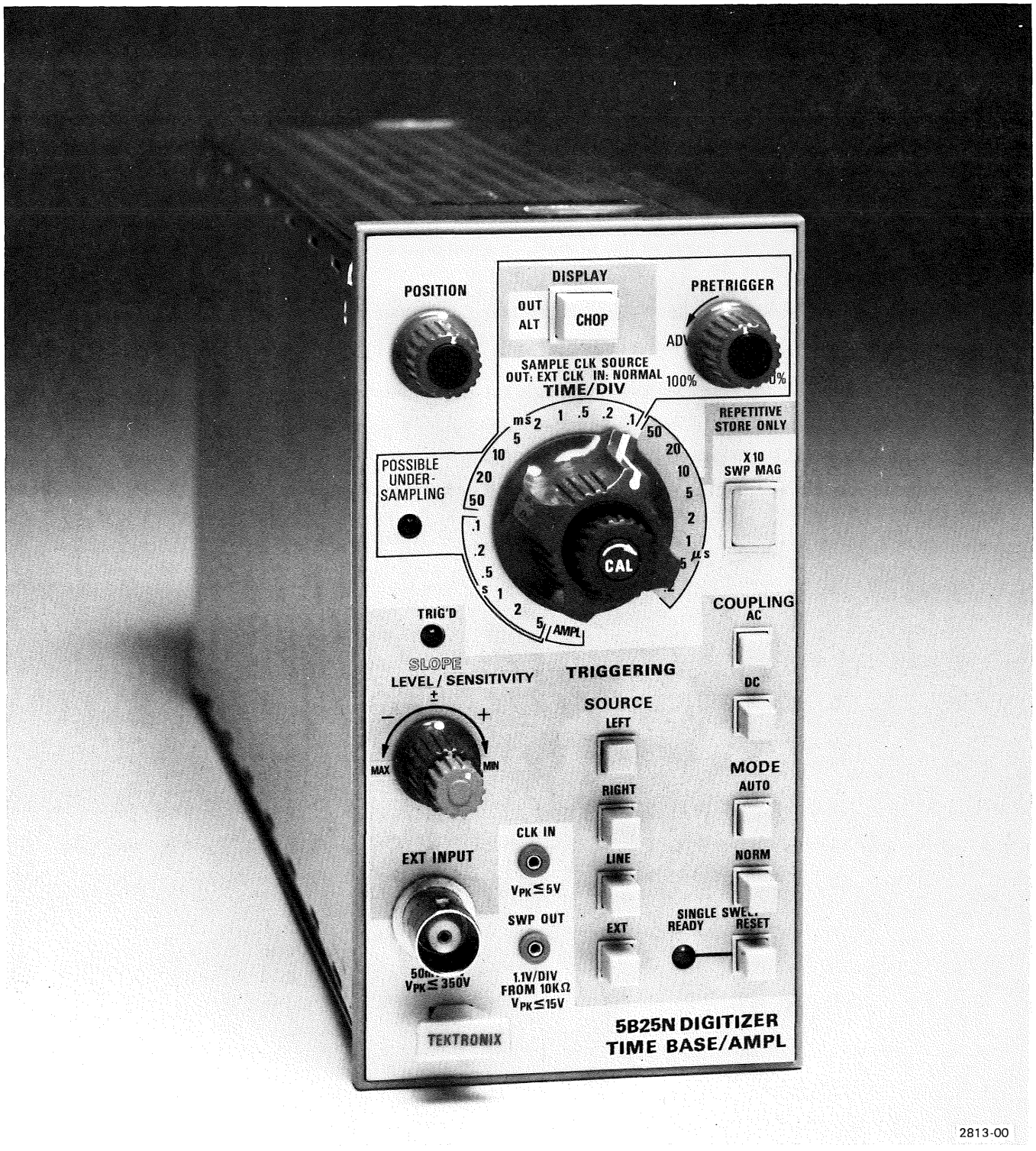
Disconnect power before removing protective panels, soldering, or replacing components.

## USE THE PROPER FUSE

To avoid fire hazard, use only the fuse specified in the parts list for your product, and which is identical in type, voltage rating, and current rating.

## DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES

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




## 5B25N FEATURES

The 5B25N Digitizer Time Base/Amplifier operates with the 5223 Digitizing Oscilloscope mainframe and one or two 5000-series plug-in units to form a digitizing oscilloscope system. It will also operate with a 5400-series oscilloscope mainframe and one or two 5000-series plug-in units to form a non-digitizing oscilloscope system. The 5B25N has calibrated sweep rates from 5s to 0.2 μs per division, triggering from dc to 20 MHz, and a X10 sweep magnifier.

# GENERAL INFORMATION

This section contains a basic content description of both the Operators and Service Manuals, a description of the 5B25N, information on instrument installation, packaging for shipment, and specifications. The Specification portion consists of three tables; Electrical, Environmental, and Physical Characteristics.

This section also contains a Standard Accessories list and a full-page instrument dimensional drawing.

The 5B25N Digitizer Time Base/Amplifier operates with a 5223 Digitizing Oscilloscope and one or two 5000-series plug-in units to form a system. The system will digitize a displayed waveform and present a memory display of that waveform after the original event.

## OPERATORS MANUAL

The Operators Manual has the following three sections:

Section 1—General Information contains instrument description, electrical specifications, environmental characteristics, standard and recommended accessories, and packaging for shipment instructions.

Section 2—Operating Instructions contains information about operating and checking the instrument operation.

Section 3—Instrument Options contains a description of available options and gives the location of the incorporated information for those options.

## SERVICE MANUAL

**WARNING**

*THE SERVICE MANUAL CONTAINS INSTRUCTIONS FOR USE BY QUALIFIED SERVICE PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING UNLESS YOU ARE QUALIFIED TO DO SO.*

Section 1—General Information, which contains instrument description, electrical specifications, environmental characteristics, standard and recommended accessories, installation, and packaging for shipment instructions.

Section 2—Operating Information contains information on instrument installation, front- and rear-panel controls, connectors and indicators, internal switches and selectors, Checkout Procedure, and other information relative to operating and checking instrument operation.

Section 3—Theory of Operation contains general and specific circuit analysis that may be useful for servicing or operating the instrument.

Section 4—Maintenance describes routine and corrective maintenance procedures with detailed instructions for replacing assemblies, subassemblies, and individual parts.

Section 5—Calibration contains procedures to check the performance and electrical characteristics of the instrument. Procedures also include methods for adjusting the instrument to meet specifications.

Section 6—Instrument Options contains a description of available options and locations of incorporated information for those options.

Section 7—Replaceable Electrical Parts contains information necessary to order replaceable parts and assemblies.

Section 8—Diagrams and Circuit Board Illustrations includes detailed circuit schematics, locations of assembled boards within the instrument, voltage and waveform information, circuit board component locators, and locations of adjustments to aid in performing the Adjustment and Performance Check part of the Calibration procedure.

Section 9—Replaceable Mechanical Parts includes information necessary to order replaceable mechanical parts and shows exploded views which identify assemblies.

## DESCRIPTION

The 5B25N Digitizer Time Base/Amplifier is an essential part of the Tektronix 5223 Digitizing Oscilloscope system. The 5223 Digitizing Oscilloscope mainframe, the 5B25N, and one or two 5000-series plug-in units constitute the 5223 system.

The 5B25N has two features that are essential to a digitizing oscilloscope system, as follows:

1. It notifies the 5223 when to sample its incoming signal.

2. The 5B25N determines which 1024-bit group of signal samples the 5223 will display. The PRETRIGGER control can vary (up to one full sweep before the trigger point) the starting point of a group of samples.

The 5B25N will also operate with a 5400-series oscilloscope mainframe and one or two 5000-series plug-in units to form a complete nondigitizing oscilloscope system. (The "N" after 5B25 means the instrument provides no readout in mainframes with readout capability.)

## INSTALLATION

The 5B25N is designed to operate in the horizontal plug-in compartment of the mainframe. It can also be installed in a vertical plug-in compartment to provide a vertical sweep on the crt. However, when used in this manner there are no internal triggering or retrace blanking provisions, and the unit may not meet specifications.

To install the 5B25N in a plug-in compartment, align the grooves in the top and bottom of the instrument with the guides at the top and bottom of the plug-in compartment. Then push the 5B25N in until its front panel is flush with the front panel of the mainframe. Even though the gain of the mainframe is standardized, the sweep calibration of the 5B25N should be checked when installed. The procedure for checking calibration of the 5B25N sweep is given in section 2 under Sweep Functions in the Checkout Procedure.

To remove the unit, pull the release latch (see Fig. 1-1) to disengage it from the mainframe, and pull it out of the plug-in compartment.

## PACKAGING FOR SHIPMENT

If this instrument is to be shipped for long distances by commercial transportation, it is recommended that the instrument be packaged in the original manner. The carton and packaging material in which your instrument was shipped should be saved and used for this purpose.

Also, if this instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag to the instrument showing the following: Owner of the instrument (with address), the name of a person at your firm, who can be contacted, complete instrument type and serial number, and a description of the service required.

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

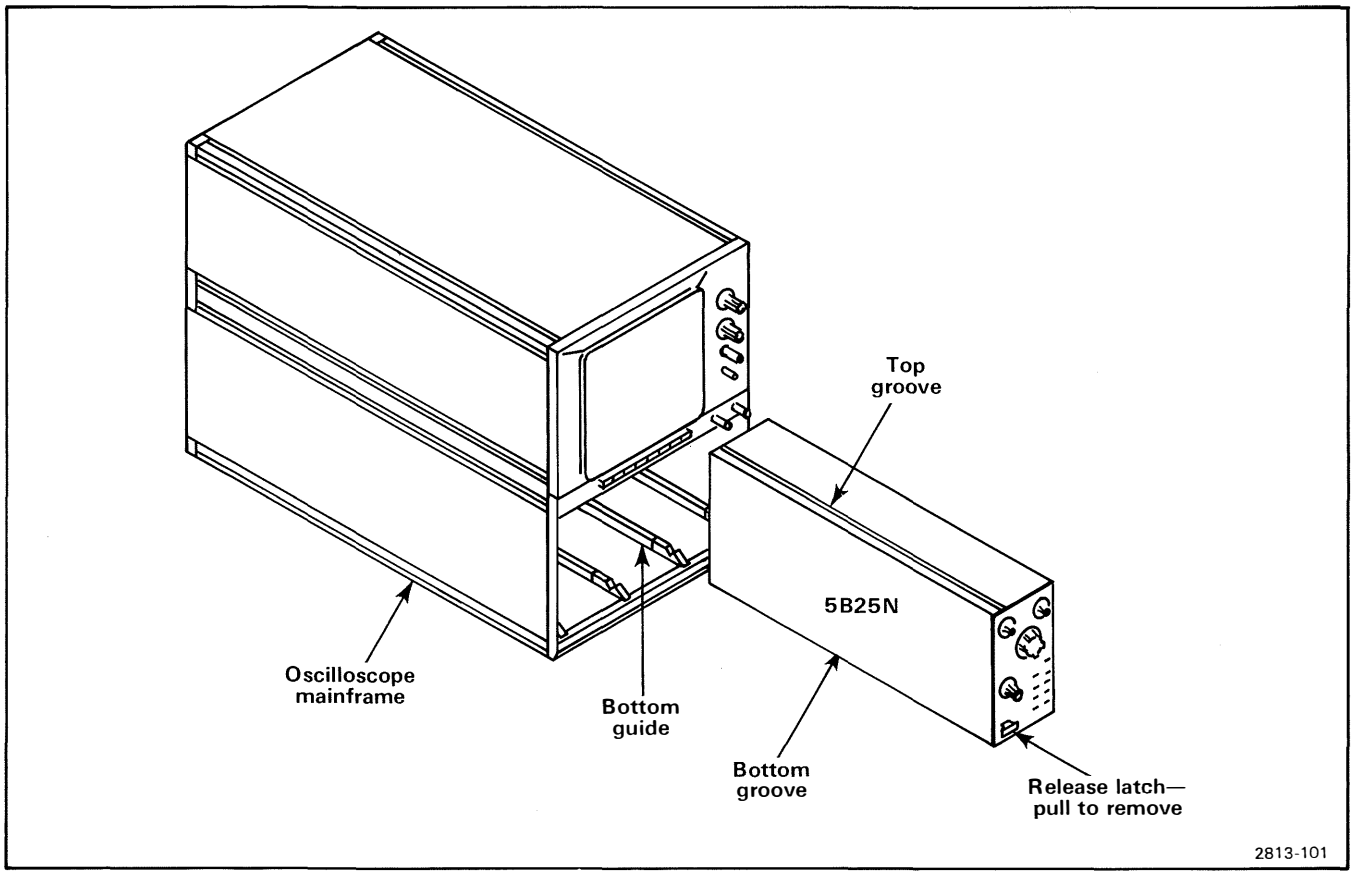



Figure 1-1. Installing and removing the 5B25N.

1. Obtain a corrugated cardboard shipping carton with a 200-pound test strength and having inside dimensions at least six inches greater than the instrument dimensions. this allows for cushioning.

2. Enclose the instrument with polyethylene sheeting or equivalent to protect the finish of the instrument.

3. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the instrument, allowing three inches on each side.

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

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

# SPECIFICATION

The 5B25N will meet the electrical characteristics listed in Table 1-1 after it is completely calibrated. The following electrical characteristics are valid over an ambient temperature range of 0° to +50° C, provided the 5B25N is calibrated in an ambient temperature of +20° to +30° C, and warmed up for 20 minutes. Except where noted otherwise, these specifications are valid when the 5B25N is installed in a 5223 or any 5400-series mainframe.

**TABLE 1-1**
**Electrical Characteristics**

| Characteristic | Performance Requirement | | | |
|---|---|---|---|---|
| **SWEEP GENERATOR** | | | | |
| Sweep Rates | | | | |
| Calibrated Range | 5 s/div to 0.2 μs/div in a 1, 2, 5 sequence. X10SWP MAGnifier extends fastest calibrated sweep rate to 20 ns/div. (The X10 SWP MAG functions on the real-time display only.) | | | |
| Variable Range | Continously variable between calibrated sweep rates. Extends sweep rate to at least 12.5 s/div. | | | |
| Sweep Accuracy Over Center 8 Divisions | +15° to +35°C Unmag | +15° to +35°C Mag | 0° to +50°C Unmag | 0° to +50°C Mag |
| 1 s/div to 0.2 μs/div | 3% | 4% | 4% | 5% |
| 2 s and 5 s/div | 4% | 5% | 5% | 6% |
| Excluded Portions of Sweep | | | | |
| Start of Sweep | 0.2 divisions +200 ns. | | | |
| End of Sweep | Unmagnified—beyond 10.5 divisions after start of sweep. | | | |
| | Magnified—beyond 105 divisions after start of sweep. | | | |

TABLE 1-1 (CONT)
Electrical Characteristics

| Characteristic | Performance Requirement |
|---|---|
| Sweep Length | At least 10.5 div at all sweep rates. |
| Position Range | |
| POSITION Control Fully CW | Start of sweep must be to right of graticule center at 1 ms/div. |
| POSITION Control Fully CCW | Must be at least 10.5 div of sweep to left of graticule center at 1 ms/div. |
| Sweep Out Voltage | |
| Open Circuit | 1.1 V/div ±5%. |
| Into 1 kΩ Load | 0.1 V/div ±6%. |

## TRIGGERING

| | |
|---|---|
| Triggering<br>+ or − Slope | |
| Sensitivity | |
| Internal Trigger with any 5A30- or 5A40-series Amplifier | 0.4 division, dc [1] to 1 MHz.<br>0.6 division, 1 MHz to 15 MHz. |
| External Trigger | 50 mV, dc[1] to 1 MHz.<br>200 mV, 1 MHz to 15 MHz. |
| ± Slope | |
| Sensitivity | |
| Internal Trigger, AC Coupling | ±0.5 division, 30 Hz to 1 MHz.<br>Will trigger to 15 MHz. |
| External Trigger | ±50 mV, dc[1] to 1 MHz.<br>Will trigger to 15 MHz. |
| Input R and C | 1 MΩ ±2% shunted by 24 pF ±4 pF. |
| Maximum Input Voltage | 350 V peak. |
| Amplifier Mode | |
| Sensitivity | 50 mV/div ±3% at 1 kHz. |
| Bandwidth | 2 MHz minimum @ −3 dB. |
| Risetime | 180 ns maximum. |
| Aberrations | Less than 5%. |

[1] 30 Hz when ac coupled.



@

TABLE 1-1 (CONT)
Electrical Characteristics

| Characteristic | Performance Requirement | | |
|---|---|---|---|
| **DIGITIZER-RELATED FUNCTIONS** | | | |
| Digitizer-Related Functions (5223 Mainframe Only) | | | |
| Overall Speed Accuracy of Digitized Signal—(Center 8 div). Excluded Portions: First 200 ns or 0.2 div of each waveform | Digitized Waveform | Digitized Waveform Relative to Real-Time Waveform | |
| | | CAL | UNCAL |
| 2 and 5 s/div | 3% | 4% | 6% |
| 1 s - 0.1 ms/div | 3% | 3% | 5% |
| 50 $\mu$s - 0.2 $\mu$s/div | 3% | 3% | 3% |
| Pretrigger Adjustment Range | Continously variable from 0% to 100% of the memory length. | | |
| Possible Undersampling Light | Operates only at sweep speeds of 0.1 ms/division and slower. Lights when there are 8 or fewer sample pulses per trigger event. | | |
| CLK IN Signal | | | |
| Voltage Limits | High, +2.4 to +5.0 V<br>Low, −0.5 to +0.4 V | | |
| Frequency Limit, Maximum | 1 MHz | | |
| **POWER SOURCE** | | | |
| Power Consumption | Less than 6.5 watts. | | |

TABLE 1-2
Environmental Characteristics

| Characteristic | Information |
|---|---|
| Temperature | |
| Operating | 0° to +50°C. |
| Storage | −55° to +75°C. |

**TABLE 1-2 (CONT)**
**Environmental Characteristics**

| Characteristic | Information |
|---|---|
| Altitude | |
| Operating | To 15,000 feet (4,500 m). |
| Storage | To 50,000 feet (15,000 m). |
| Vibration | |
| Operating and Non-operating | Tested to MIL-T-28800B Section 4.5.5.3.1 Type 2. Class 5. Style E & F. |
| Shock | |
| Nonoperating | Tested to MIL-T-28800B. Section 4.5.5.4.1 Type 2. Class 5. Style E & F. |
| Bench Handling | Tested to MIL-T-28800B. Section 4.5.5.4.4. Type 2. Class 5. Style E & F. |
| Transportation | National Safe Transit Assoc., Pre-Shipment Test procedure. |
| Vibration of Packaged Product | Project 1 A-B-1. |
| Drop of Packaged Product | NSTA. Project 1 A-B-2. |
| Humidity | |
| Operating and Storage | Five days, per MIL-STD-810C, Method 507-1, Procedure 4, except 90-95% RH. |
| Electromagnetic Compatibility | Tektronix Product Design Standard 062-2866-00. |

**TABLE 1-3**
**Physical Characteristic**

| Characteristic | Information |
|---|---|
| Net Weight | About 2.06 lb. (0.93 kg). |
| Overall Dimensions | See Figure 1-2, the dimensional drawing. |

# STANDARD ACCESSORIES

1 ea ..... Operators Manual

1 ea ..... Service Manual

For more detailed information refer to the tabbed Accessories page at the rear of this manual.



@

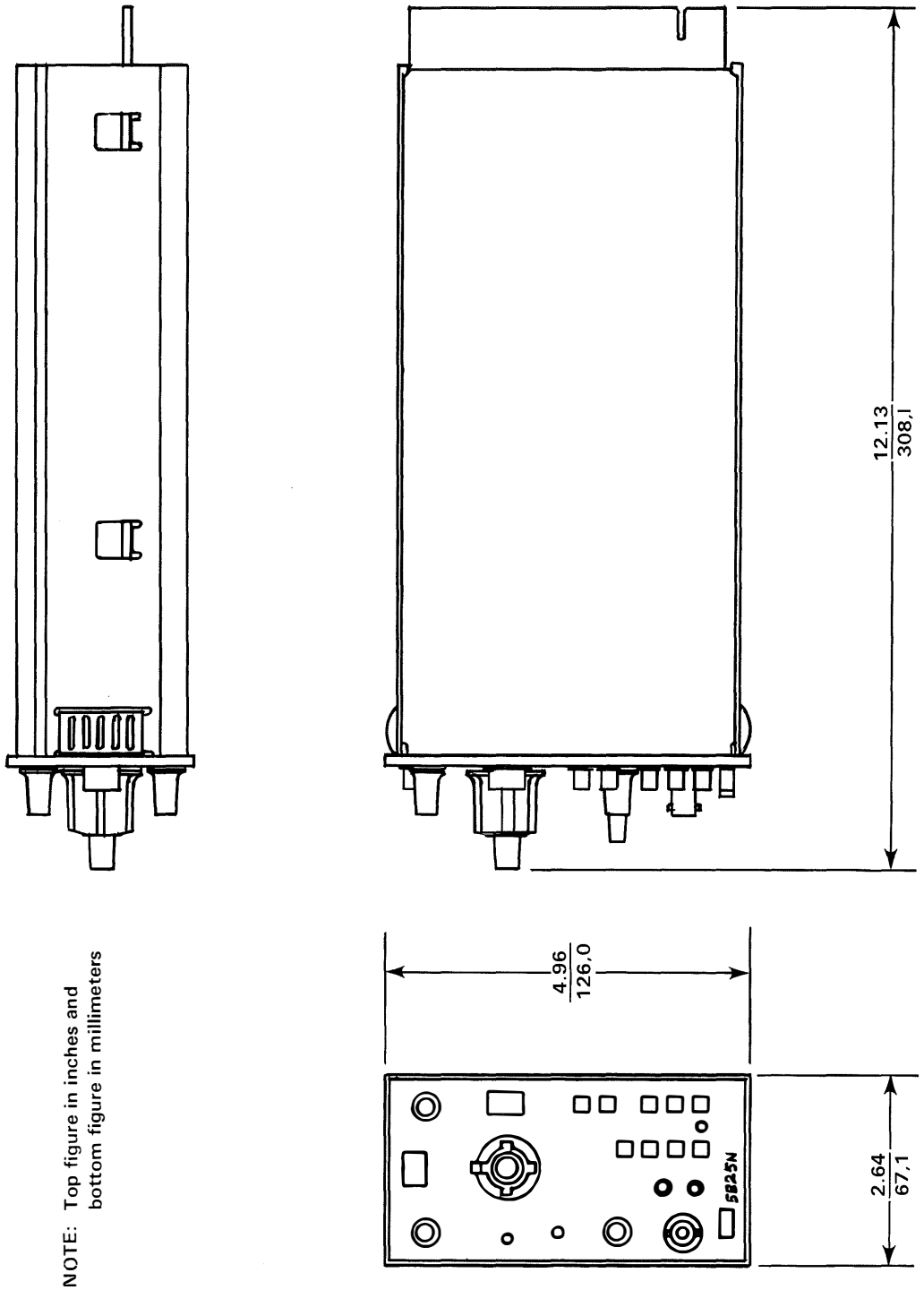



Figure 1-2. Dimensions of 5B25N.

# OPERATING INFORMATION

The 5B25N Digitizer Time-Base/Amplifier operates with a Tektronix 5223 or any 5400-series oscilloscope mainframe and one or two 5000-series plug-in unit(s) to form a complete oscilloscope system. This section describes the operation of the front-panel controls and connectors, provides a Checkout Procedure, detailed operating information, and basic applications for the 5B25N.

## CONTROLS, CONNECTORS, AND INDICATORS

All controls, connectors, and indicators required for the operation of the time-base unit are located on the front panel. Figure 2-1 provides a brief description of all front-panel controls, connectors, and indicators. More detailed information is given in the Detailed Operating Information section.

## CHECKOUT PROCEDURE

The following procedures are provided for checking basic instrument functions. Refer to the description of the controls, connectors, and indicators while performing this procedure. If performing the Checkout Procedure reveals a malfunction or possible misadjustment, first check the operation of the associated equipment, then refer to qualified service personnel for repair or adjustment of the instrument.

### PRELIMINARY SETUP

1. Install the time base being checked in the horizontal compartment of the mainframe.

2. Install an amplifier plug-in in the left vertical compartment.

3. Set the time-base controls as follows:

SLOPE ..... (+)
MODE ..... AUTO
COUPLING ..... AC
SOURCE ..... LEFT
POSITION ..... Midrange
TIME/DIV ..... 1 ms
CAL ..... Calibrated (fully clockwise)
X10 SWP MAG ..... X1 (out)
DISPLAY ..... CHOP (in)

4. Turn on the mainframe and allow at least 20 minutes warmup.

5. Adjust the mainframe Intensity and Focus controls for a well-defined display. See the oscilloscope mainframe and amplifier unit instruction manuals for detailed operating instructions.

### SWEEP FUNCTIONS

#### Normal Sweep

Perform the following procedure to obtain a normal sweep and to demonstrate the function of the related controls:

1. Perform the preceding Preliminary Setup.

2. Connect a 0.3-volt, 1-kilohertz signal from the mainframe calibrator to the vertical amplifier input.

3. Set the amplifier unit deflection factor for 3 divisions of display.

4. Adjust the LEVEL/SENSITIVITY control for a stable display.

5. Rotate the POSITION control and observe that the trace moves horizontally.

6. Check the waveform display for one complete cycle per division, ±4%. The ±4% includes ±1% for the 5223 calibrator signal and ±3% for the 5B25N sweep.

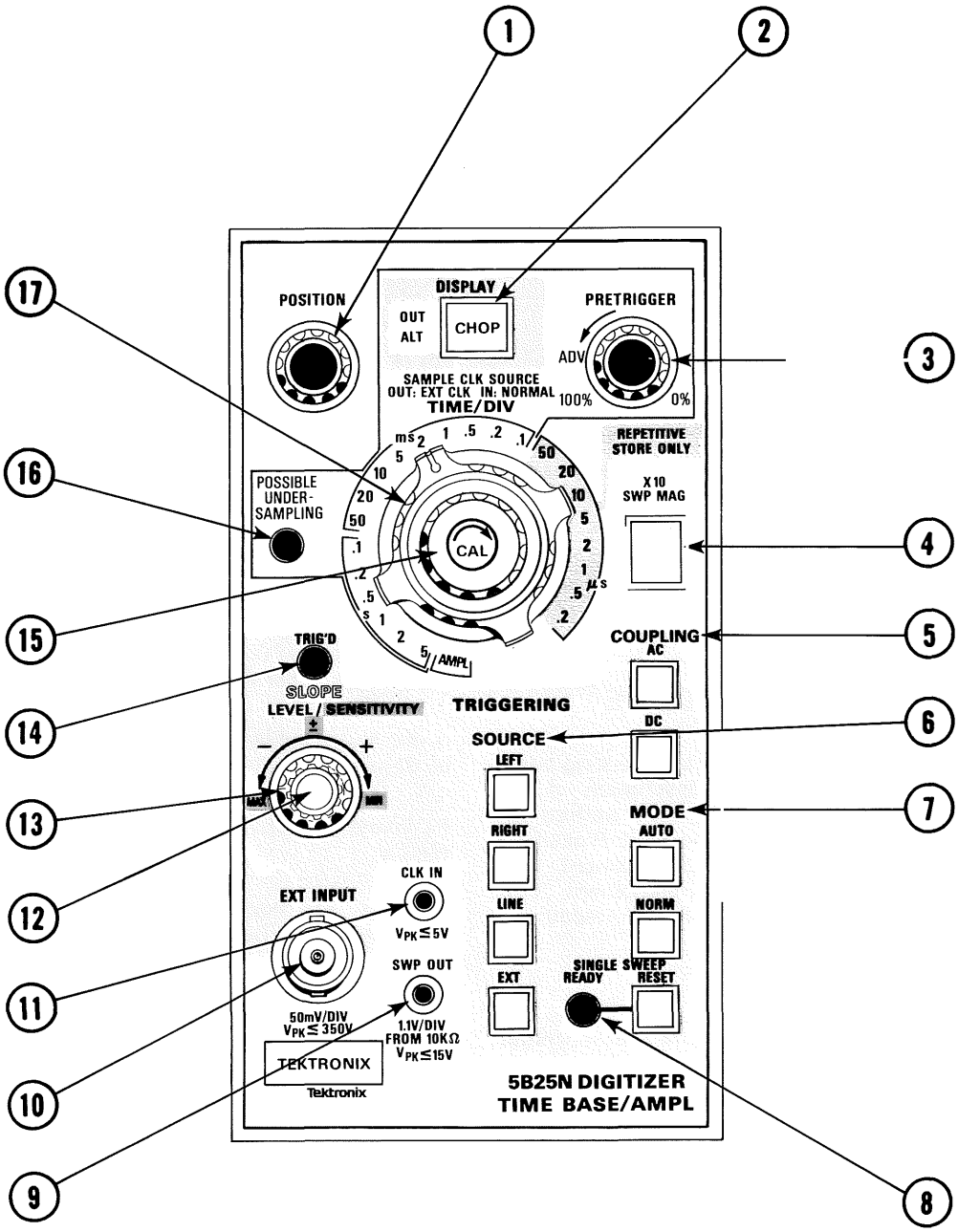
7. Rotate the CAL control fully counterclockwise and observe that the displayed sweep rate changes to at least the next slower TIME/DIV switch setting (i.e., 2 milliseconds/division). Return the CAL knob to the calibrated position.

#### Magnified Sweep

Perform the following procedure to obtain a X10 magnified display and to demonstrate the function of the related controls:

1. Obtain a one-cycle-per-division display as described in the preceding Normal Sweep procedure.

2. Press the X10 SWP MAG button. Observe that the cycle displayed at the horizontal center of the graticule expands to about 10 divisions.




2813-201A

Figure 2-1. Front-panel controls, connectors and indicators.

(1) **POSITION Control**—Positions the crt display horizontally.

(2) **DISPLAY Pushbutton***—Selects display mode of mainframe (chop or alternate).

(3) **PRETRIGGER Control***—Selects the amount of information preceding the trigger point that will be stored in the 5223 memory.

(4) **X10 SWP MAG Pushbutton**—When pressed in, selects X10 magnified sweep. Illuminates when pressed in.

(5) **COUPLING Pushbuttons**—Selects method (AC or DC) of coupling the trigger signal to the trigger circuit.

(6) **SOURCE Pushbuttons**—Selects source (LEFT, RIGHT, LINE or EXT) of the trigger signal.

(7) **MODE Pushbuttons**—Selects the operating mode (AUTO, NORM or SINGLE SWEEP) of the trigger circuit.

(8) **READY Indicator**—Lights when the sweep circuit is armed (SINGLE SWEEP button must be pressed in).

(9) **SWP OUT Connector**—Provides sweep ramp signal for external use.

(10) **EXT INPUT Connector**—Signals applied to the EXT INPUT connector can be:

a. Used to trigger the sweep when the EXT SOURCE button is pressed in, or

b. Displayed when the TIME/DIV control is set to the AMPL position.

(11) **CLK IN Connector**—A pin jack that provides a means of introducing an external sample pulse to the 5B25N.

(12) **SLOPE Control**—Permits sweep to be triggered on negative, positive, or both positive- and negative-going parts of the trigger signal.

(13) **LEVEL/SENSITIVITY Control**—Selects a point on the triggering signal where triggering occurs. When ±SLOPE is selected, adjusts the triggering threshold.

(14) **TRIG'D Indicator**—Illuminates when the sweep is triggered.

(15) **CAL Control**— a. Selects calibrated or uncalibrated sweep rates. Uncalibrated sweep rates can be continuously reduced to at least the next slowest rate.

b. The CAL control is also a pushbutton control which selects the source of sample clock pulses. When the CAL control is pressed in, the 5B25N supplies a sample pulse to the 5223. When the CAL control is released (out), external sample pulses can reach the 5223 via the CLK IN connector on the 5B25N front panel.

(16) **POSSIBLE UNDERSAMPLING Indicator***—Lights when eight or fewer sample pulses are sent to the 5223 per trigger event, i.e., per cycle of repetitive input signal.

(17) **TIME/DIV Control**—Selects the sweep rate of the sweep generator. When in the AMPL position, the time base functions as an amplifier.

* When the TIME/DIV control is in the shaded area (between 0.2$\mu$s to 50$\mu$s), the PRETRIGGER and DISPLAY controls are disabled and the POSSIBLE UNDERSAMPLING indicator does not function.

2813-201B

**Figure 2-1 (cont). Front-panel controls, connectors and indicators**

3. Release the X10 SWP MAG button by pressing it.

### Display

This procedure compares the alternate and chopped functions as controlled by the 5B25N DISPLAY button. Use a dual-channel vertical amplifier plug-in set for dual-trace operation, or two single-trace amplifiers with their Display buttons pressed.

1. Set the TIME/DIV control to 10 ms and obtain a display of both channel 1 and channel 2 sweeps. (Or, with two single-trace amplifiers, both left and right traces.)

2. Release the DISPLAY button to set the horizontal display mode to ALTernate.

3. Observe that the display is now switching in the alternate mode, i.e., two channel 1 sweeps and then two channel 2 sweeps. (Or, with two single-trace amplifiers, one left, then one right trace.)

4. Press the DISPLAY button in.

5. Observe that two sweeps are displayed.

## TRIGGERING FUNCTIONS

Perform the following procedure to obtain a triggered sweep and to demonstrate the functions of the related controls:

1. Obtain a display as described in the preceding Normal Sweep procedure.

2. Alternately press the AC and DC COUPLING buttons for both the + and – positions of the SLOPE control and check for a stable display (the LEVEL/SENSITIVITY control may be adjusted, if necessary, to obtain a stable display).

3. Apply the 0.3-volt, 1-kilohertz signal from the mainframe calibrator to the vertical amplifier and to the EXT INPUT connector.

4. Press the EXT SOURCE button and set the vertical amplifier deflection factor for a three-division display.

5. Press the AC and DC COUPLING buttons in both the + and – positions of the SLOPE control and check for a stable display (the LEVEL/SENSITIVITY control may be adjusted, if necessary).

6. Press the AC COUPLING button and set the SLOPE control to ± (bislope). Rotate the LEVEL/SENSITIVITY control to the MAXimum position (fully counterclockwise).

7. Observe that the sweep is triggered. Rotate the LEVEL/SENSITIVITY control towards the MINimum position (clockwise).

8. Observe that at some point the sweep becomes untriggered and free-runs. The sweep will start free-running because the ±SENSITIVITY control has moved the + and – triggering points beyond the + and – amplitude extremes of the input signal.

**NOTE**

*DC COUPLING is not recommended in the ± SLOPE mode (from INTernal source) because of inherent dc offset in the trigger path of some vertical plug-in units.*

9. Press the LEFT SOURCE and AUTO MODE buttons and adjust the LEVEL/SENSITIVITY control for a free-running display.

10. Press the NORM MODE button and check for no display.

11. Adjust the LEVEL/SENSITIVITY control for a stable display and press the SINGLE SWEEP RESET button.

12. Verify that one trace occurs each time the SINGLE SWEEP RESET button is pressed and released.

13. Disconnect the mainframe calibrator signal from the vertical amplifier input and press the SINGLE SWEEP RESET button. Check for no display and note that the READY indicator is lit.

14. Observe that one trace occurs and that the READY indicator extinguishes when the mainframe calibrator signal is reconnected to the vertical amplifier input.

15. Disconnect the calibrator signal from the vertical amplifier and the 5B25N EXT INPUT connector.

16. Set the TIME/DIV control fully counterclockwise to the AMPL position and press the LINE SOURCE button. Observe that one horizontal trace extends across the entire crt graticule of the mainframe.

## POSSIBLE UNDERSAMPLING INDICATOR

Perform the following procedure to demonstrate the function of the POSSIBLE UNDERSAMPLING indicator.

1. Obtain a display as described in the preceding Normal Sweep procedure.

2. Connect a 50 kHz signal from a sine-wave generator to the vertical amplifier input with a coaxial cable and a 50-ohm terminator.

3. Set the amplifier deflection factor to 0.5 V/Div.

4. Adjust the output amplitude of the sine-wave generator to produce a three-division display on the crt.

5. Set the 5B25N TIME/DIV control to 50 μs.



@

6. Press the 5223 Display Left and Vector Mode buttons.

7. Use the 5223 Vert and Horiz Posn controls to position the memory display so that it can be viewed separately from the real-time display.

8. Observe that rotating the TIME/DIV control counterclockwise one step at a time causes the appearance of the memory display to differ from the real-time display. At some setting the POSSIBLE UNDERSAMPLING indicator will come on, showing that the system is taking too few samples to accurately reconstruct the input signal.

Figure 2-2A, B, and C shows the display at 50 μs, 0.2 ms and 0.5 ms/division. At 50 μs/div (Fig. 2-2A), the memory display (bottom) is a good reproduction of the real-time display (top). At 0.2 ms/div (Fig. 2-2B), the memory display is still a fair reproduction of the real-time display, but some confusing light and dark areas are evident. At 0.5 ms/div (Fig. 2-2C), it is difficult to relate the memory display to the real-time display and the POSSIBLE UNDERSAMPLING indicator is lighted.

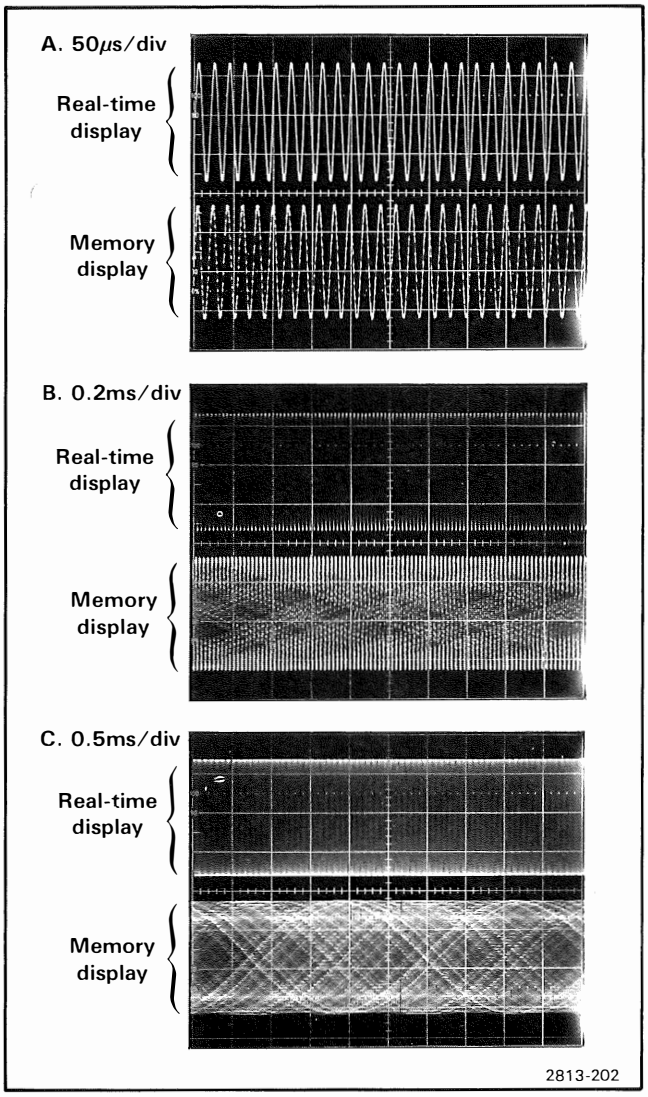



Figure 2-2. Real-time and memory displays of 50 kHz signal at 50 μs, .2 ms, and .5 ms/division.

## PRETRIGGER CONTROL

Perform the following procedure to demonstrate the function of the PRETRIGGER control.

1. Obtain a display as described in the preceding Normal Sweep procedure.

2. Connect the Calibrator signal from the mainframe to the input of the vertical amplifier plug-in.

3. Set the deflection factor of the amplifier to provide a two-division display.

4. Press the 5223 Display Left button.

5. Adjust the 5223 Mem Inten control so that the memory display is of low-to-moderate brightness. This will let you easily see the trigger point, because the display is intensified during the time before the trigger event.

6. Use the 5223 Vert and Horiz Posn controls to position the memory display so that it can be viewed separately from the real-time display.

7. Observe that turning the PRETRIGGER control counterclockwise from 0% causes the memory display to move across the screen from left to right. The part of the display that occurred before the trigger point is brighter than the part that occurred after the trigger point. You can verify this by varying the setting of the 5223 Mem Inten control. Figure 2-3 shows a typical display with the PRETRIGGER control set to about 50%.

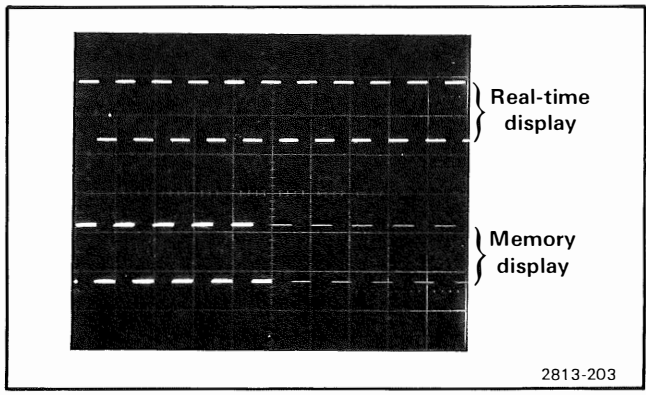



Figure 2-3. Real-time and memory displays of 5223 Calibrator signal with PRETRIGGER control set to about 50%.

# DETAILED OPERATING INFORMATION

## TRIGGERING SWITCH LOGIC

The TRIGGERING group of controls includes the MODE, COUPLING, and SOURCE pushbuttons which are used to obtain a stable display on the mainframe crt. When an adequate trigger signal is applied and the LEVEL/SENSITIVITY control is correctly set the 5B25N is triggered, as indicated by the illuminated TRIG'D light. Refer to the following discussions or the instruction manuals for the associated oscilloscope mainframe and vertical unit(s) for more information.

## TRIGGERING MODE

The MODE pushbutton switches select the mode in which the sweep is triggered.

### Auto

The AUTO MODE provides a triggered display with the correct setting of the LEVEL/SENSITIVITY control whenever an adequate trigger signal is applied (see Trigger Level discussions). The TRIG'D light indicates that the sweep is triggered.

When the trigger repetition rate is outside the frequency range selected by the COUPLING switch or the trigger signal amplitude is inadequate, the sweep free runs at the rate indicated by the TIME/DIV control (TRIG'D indicator will be off). An adequate trigger signal ends the free-running condition and a triggered display will be presented. The sweep also free runs at the rate indicated by the TIME/DIV control when the LEVEL/SENSITIVITY control is at a setting outside the amplitude range of the trigger signal. This type of free-running display is useful when it is desired to measure only the peak-to-peak amplitude of a signal without observing the waveshape (such as bandwidth measurements). The triggering circuit will not operate in AUTO mode below about 25 hertz. To trigger effectively below about 25 hertz, use the NORMal triggering mode.

### Normal

The NORM MODE provides a triggered display with the correct settings of the LEVEL/SENSITIVITY control whenever an adequate trigger signal is applied. The TRIG'D light indicates that the sweep is triggered.

The normal trigger mode must be used to produce triggered displays with trigger repetition rates below about 25 hertz. When no trace is displayed, the TRIG'D light is off.

### Single Sweep

When the signal to be displayed is not repetitive or varies in amplitude, waveshape, or repetition rate, a conventional repetitive type sweep may produce an unstable display. Under these circumstances, a useful display can often be obtained by using the single-sweep feature.

To demonstrate a single-sweep display of a repetitive signal, first connect the mainframe calibrator signal to the vertical amplifier and obtain the best possible display in the NORM MODE. Then, without changing the other TRIGGERING controls, remove the calibrator signal and press the SINGLE SWEEP RESET button. The SINGLE SWEEP READY indicator should light. Reconnect the calibrator signal to the vertical amplifier. A single sweep of the calibrator signal should occur. Further sweeps cannot take place until the SINGLE SWEEP RESET button is pressed again. If the displayed signal is a complex waveform composed of varying amplitude pulses, successive single-sweep displays may not start at the same point on the waveform. At fast sweep rates, it may be difficult to view the single-sweep display. The apparent trace intensity can be increased by reducing the ambient light level or by using a viewing hood as recommended in the mainframe instruction manual.

When using the single-sweep mode to photograph waveforms, the graticule may have to be photographed separately in the normal manner to prevent overexposing the film. Be sure the camera system is well protected against stray light, or operate the system in a darkened room. For repetitive waveforms, press the SINGLE SWEEP RESET button only once for each waveform unless the signal is completely symmetrical. Otherwise, multiple waveforms may appear on the film. For random signals, the lens can be left open until the signal triggers the 5B25N. Further information on photographic techniques is given in the appropriate camera instruction manual.

## TRIGGERING COUPLING

The TRIGGERING COUPLING pushbuttons select the method of coupling the trigger signal to the trigger circuits.

### AC

AC COUPLING blocks the dc component of the trigger signal. Signals with components below about 30 hertz are attenuated. AC coupling can be used for most applications. However, if the sweep is to be triggered at a low repetition rate or by a dc level, DC coupling will provide a better display.

### DC

DC COUPLING can be used to provide stable triggering from low-frequency signals which would be attenuated in the AC COUPLING control position. The DC COUPLING control position can be used to trigger the sweep when the trigger signal reaches a dc level set by the LEVEL/SENSITIVITY control.

## TRIGGERING SOURCE

The TRIGGERING SOURCE pushbuttons select the source of the trigger signal which is connected to the trigger circuits. When the TIME/DIV control is set to AMPL, they select the source of the signal to be applied to the horizontal deflection channel.

### Left, Right

The LEFT and RIGHT positions connect trigger signals from the vertical plug-in units. Further selection of the internal trigger signal may be provided by a vertical plug-in unit; see the instruction manuals for these instruments for more information. For most applications, the internal source can be used. However, some applications require special triggering which cannot be obtained internally. In such cases, the LINE or EXT positions of the SOURCE switches must be used.

### Line

The LINE position connects a sample of the power-line voltage from the mainframe to the trigger circuit. Line triggering is useful when the input signal is time-related (multiple or submultiple) to the line frequency. It is also useful for providing a stable display of a line-frequency component in a complex waveform.

### External

The EXT position connects the signal from the EXT INPUT connector to the trigger circuit. The external signal must be time-related to the displayed waveform for a stable display. An external trigger signal can be used to provide a triggered display when the internal signal is either too low in amplitude for correct triggering or contains signal components on which triggering is not desired. External triggering is also useful when signal tracing in amplifiers, phase-shift networks, wave-shaping circuits, etc. The signal from a single point in the circuit can be connected to the EXT INPUT connector through a probe or cable. The sweep is then triggered by the same signal at all times and allows amplitude, time relationship, or waveshape changes of signals at various points in the circuit to be examined without resetting the TRIGGERING controls.

When the TIME/DIV control is in the AMPL position and the EXT SOURCE switch is pressed in, a signal applied to the EXT INPUT connector will be displayed horizontally on the mainframe crt. The sensitivity is 50 mV/div. Other sources of horizontal deflection voltage may also be selected, i.e., LEFT, RIGHT, or LINE.

## TRIGGERING SLOPE

In the + or − positions, the TRIGGERING SLOPE control (concentric with the TRIGGERING LEVEL/SENSITIVITY control) determines whether the trigger circuit responds on the positive- or negative-going portion of the trigger signal. When the SLOPE switch is in the + (positive-going) position, the display starts on the positive-going portion of the waveform (see Fig. 2-4). When several cycles of a signal appear on the display the setting of the SLOPE switch is often unimportant. However, if only a certain portion of a cycle is to be displayed, correct setting of the SLOPE switch is important to provide a display that starts on the desired slope of the input signal.

Setting the SLOPE switch to the ± position activates the dual or bislope function of the time base. Bislope triggering allows capture (and storage using a 5223 mainframe) of a signal which exceeds, either positive or negative, a particular level. This level is adjustable over a wide range by varying the LEVEL/SENSITIVITY control; in this case, the control adjusts the sensitivity of the trigger circuits.

## TRIGGERING LEVEL/SENSITIVITY

The TRIGGERING LEVEL/SENSITIVITY control has two functions that depend on the setting of the SLOPE selector.

When the SLOPE selector is set to + or −, the LEVEL/SENSITIVITY control functions as a LEVEL control. Turning the LEVEL control clockwise selects a more positive part of the input signal as the trigger point. Conversely, counterclockwise rotation selects a more negative part of the signal as the trigger point.

When the SLOPE selector is set to ± (bislope), the LEVEL/SENSITIVITY control functions as a SENSITIVITY control. The counterclockwise extreme is MAXimum sensitivity, and the clockwise extreme is MINimum sensitivity.

The LEVEL/SENSITIVITY control adjusts the sensitivity threshold when the SLOPE switch is in the ± position. Adjusting the sensitivity threshold allows the operator to view a signal (or signals) which exceed a selected positive or negative level.

To set the LEVEL control, first select the TRIGGERING MODE, COUPLING, SOURCE, and SLOPE. Then set the LEVEL/SENSITIVITY control fully counterclockwise and rotate it clockwise until the display starts at the desired point.

To set the SENSITIVITY control, first select the TRIGGERING MODE, COUPLING, SOURCE and SLOPE. Then set the SENSITIVITY control fully counterclockwise to MAX. If the input signal is of sufficient amplitude (see Specification in Section 1), the trigger circuit will start the sweep. Turning the SENSITIVITY control clockwise, from its MAX sensitivity position, moves the + and − trigger threshold levels away from their maximum sensitivity levels. The + level becomes more positive and the − level becomes more negative, and the trigger circuit will require a larger input signal to operate. The trigger circuit will start the sweep when the input crosses either + or − threshold level.

The bislope feature is useful for detecting low-level, randomly occurring events and storing them for continuous viewing in the 5223 mainframe.

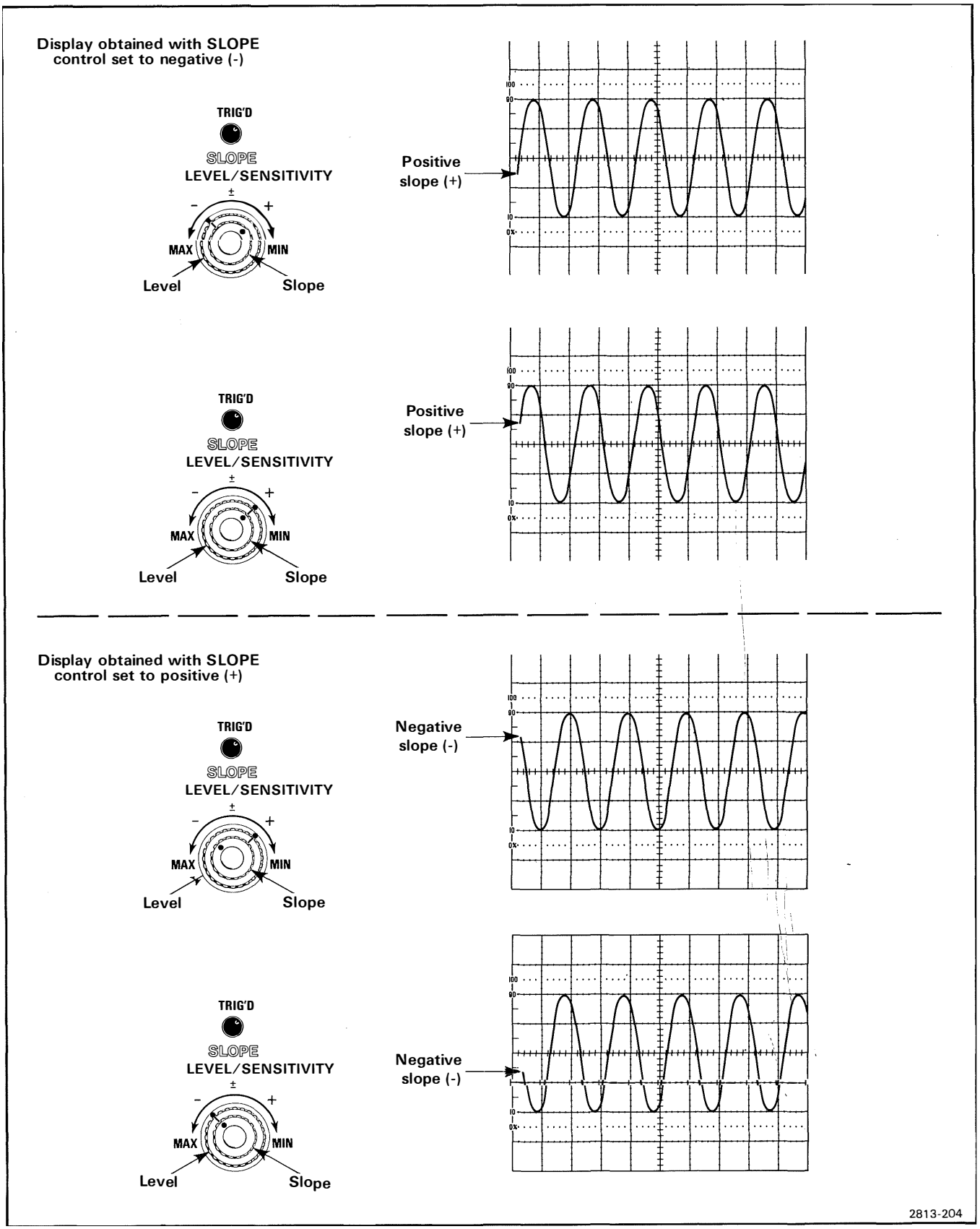



Figure 2-4. Effect of LEVEL/SENSITIVITY and SLOPE controls on crt display.

## SWEEP RATES

The TIME/DIV control provides calibrated sweep rates from 5 seconds/division to 0.2 microseconds/division in a 1-2-5 sequence. The CAL control must be in its calibrated position and the X10 SWP MAG button set to X1 to obtain the sweep rate indicated by the TIME/DIV control.

The CAL control has a detent to indicate if the sweep rate is calibrated or uncalibrated. When the CAL control is in the detent position, the sweep rate is calibrated. When out of detent the CAL control provides for uncalibrated sweep rates, to at least the sweep rate of the next slower position.

### Alternate and Chopped Operation

The pushbutton labeled CHOP in the blue DISPLAY area of the front panel selects the switching mode for dual-channel vertical plug-ins or dual vertical-channel mainframes. With the button out and the 5B25N in a 5223 mainframe, the switching is in the alternate mode, i.e., one vertical channel is displayed for two sweeps, then the other channel is displayed for two sweeps (except for the 5A14, which will alternate at one sweep per channel). When the 5B25N is in a 5400-series mainframe, alternate operation causes one sweep per channel. This will be apparent at sweep speeds of 10 ms/div and slower.

Pushing the CHOP button in selects the CHOP mode. Use the chopped mode for viewing slower dual-trace displays and the alternate mode for viewing faster displays. In the 5223 mainframe, only alternate display is available at sweep speeds of 50 $\mu$s/div and faster.

## DIGITIZER FUNCTIONS

When the 5B25N is installed in a 5223 Digitizing Oscilloscope and the TIME/DIV control is in one of the 0.1 ms to 5 s positions, the following functions are activated:

### Pretrigger Viewing

The PRETRIGGER control adjusts the amount of information, preceding the trigger, to be stored in the 5223 memory when the 5B25N operates in the real-time sampling mode (0.1 ms to 5 s/division). Rotating the control from 0% (fully clockwise) to 100% (fully counterclockwise) varies the point at which the mainframe memory stops recording data. Thus, any point up to 10.24 divisions (100%) preceding the trigger may be viewed by adjusting the PRETRIGGER control accordingly.

### Possible Undersampling

The POSSIBLE UNDERSAMPLING indicator lights when eight or fewer pulses are sent to the 5223 per trigger event, i.e., per cycle of repetitive input signal. This indicator alerts the operator to many combinations of sweep speed and signal frequency which could produce misleading stored information.

When the TIME/DIV control is set to the shaded REPETITIVE STORE ONLY area, the 5B25N operates in equivalent-time sampling mode. In this mode the PRETRIGGER, POSSIBLE UNDERSAMPLING, and DISPLAY functions are disabled. The display is locked in alternate mode.

**NOTE**

*The 5223 stored waveform may not be a replica of the real-time waveform when the 5B25N is in the ± SLOPE TRIGGERING mode, the TIME/DIV switch is in one of the shaded REPETITIVE STORE ONLY positions, and the 5223's Vector Mode button is pressed in.*

## TIME MEASUREMENTS

When making time measurements from the graticule, the area of the crt between the second and tenth vertical lines of the graticule provides the most linear measurements (see Fig. 2-5). Position the start of the timing area to the second vertical line and set the TIME/DIV control so that the end of the timing area falls between the second and tenth vertical lines.

## SWEEP MAGNIFICATION

The sweep magnifier can be used to expand the display by a factor of 10. The part of the unmagnified display that is at horizontal center will be on screen when the X10 MAG button is pressed (see Fig. 2-6). The equivalent length of the magnified sweep is more than 100 divisions; any 10-division portion can be viewed by adjusting the POSITION control to bring the desired portion into the viewing area. When the X10 SWP MAG switch is set to the X10 position (in), the equivalent magnified sweep rate can be determined by dividing the TIME/DIV setting by 10.

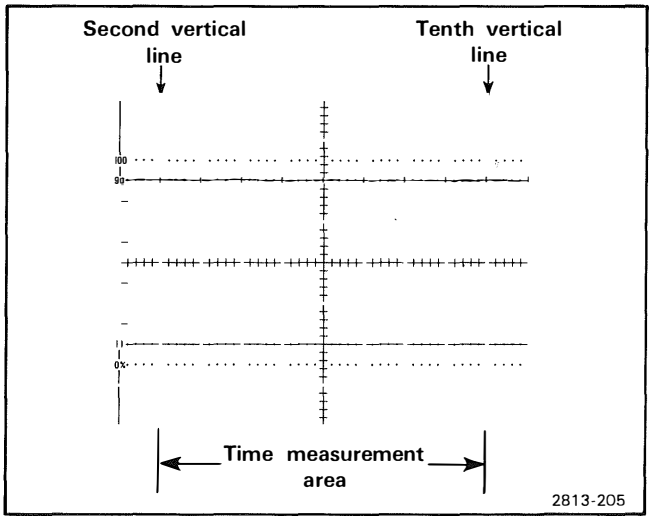



**Figure 2-5. Area of graticule where crt is most accurate.**

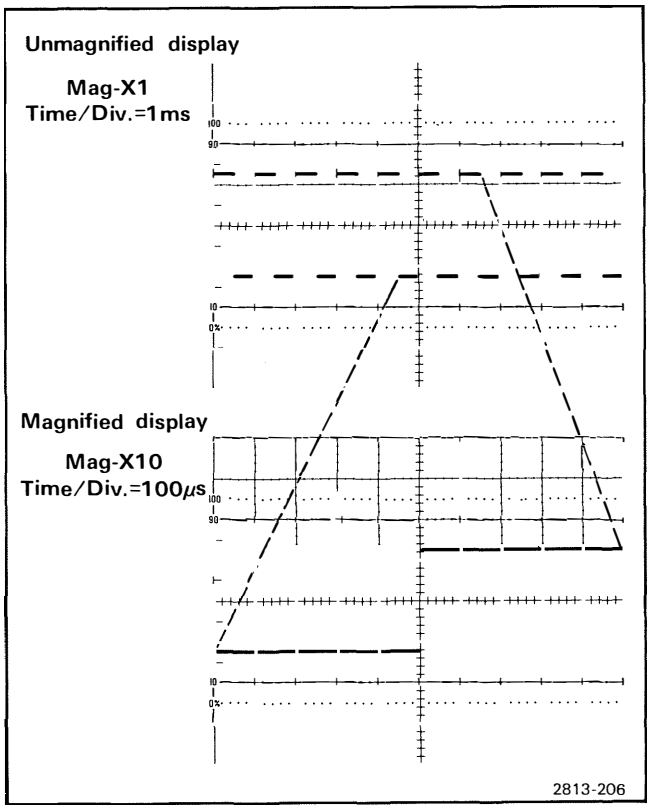



**Figure 2-6. Operation of sweep magnifier.**

## MAINFRAME OPERATING MODES

The 5B25N can operate as an independent time base in any Tektronix 5400-series oscilloscope mainframe, or as a digitizer time base in the 5223 mainframe. Refer to the mainframe instruction manual for additional information.

# APPLICATIONS

The following information describes procedures and techniques for making basic time measurements with the 5B25N in a Tektronix 5223 or a 5400-series oscilloscope mainframe. These procedures provide enough detail to enable the operator to adapt them to other related time measurements. Contact your Tektronix Field Office or representative for assistance in making other measurements.

## TIME-INTERVAL MEASUREMENTS

Because displayed time is a function of the sweep rate and the horizontal distance (in divisions) that the sweep travels across the graticule in a calibrated-sweep oscilloscope system, the time interval between any two points on a waveform can be accurately measured. The following procedures provide methods to measure some of the more common time-related characteristics of a waveform such as period, frequency, rise time, fall time, and pulse width. For greatest accuracy, make time-interval measurements in the center eight divisions of the crt graticule.

### Period And Frequency

Use this procedure to measure the period and determine the frequency of a displayed waveform:

1. Install the 5B25N in the mainframe horizontal compartment.

2. Connect the signal to be measured to the vertical amplifier input.

3. Set the display controls to display the time base and vertical units. (Check that the CAL control is fully clockwise—in its detent.)

4. Set the TRIGGERING and LEVEL/SENSITIVITY controls for a stable display (see General Operating Information for selecting proper triggering).

5. Set the vertical deflection factor and position control for about a five-division display, vertically centered on the graticule.

6. Set the TIME/DIV and POSITION controls for a complete cycle displayed within the center eight graticule divisions as shown in Figure 2-7.

7. Measure the horizontal distance in divisions over one complete cycle of the displayed waveform.

8. Multiply the horizontal distance measured in step 7 by the TIME/DIV control setting. (Divide the answer by 10 if sweep magnification is used.)

Example: Assume that the horizontal distance over one complete cycle is seven divisions, and the TIME/DIV control setting is 0.1 ms (see Fig. 2-7).

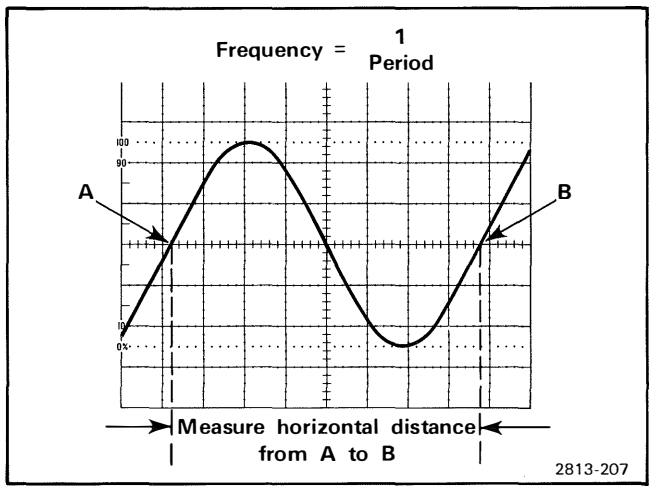



**Figure 2-7. Measuring the period and calculating the frequency of a displayed waveform.**

Using the formula:

$$\text{Period} = \frac{\text{Horizontal Distance}}{\text{TIME/DIV setting magnification}} \times$$

Substituting values:

$$\text{Period} = 7 \times 0.1 \text{ ms} \div 1 = 0.7 \text{ millisecond}$$

9. Determine the frequency of the displayed waveform obtained in steps 1 through 8 by taking the reciprocal of the period of 1 cycle.

EXAMPLE: Assume that the period of the displayed waveform is 0.7 millisecond.

Using the formula:

$$\text{Frequency} = \frac{1}{\text{period}}$$

Substituting values:

$$\text{Frequency} = \frac{1}{0.7 \text{ ms}} = 1.43 \text{ kilohertz}$$

## Rise Time And Fall Time

Use this procedure to measure the rise time and fall time of a displayed waveform:

1. Install the 5B25N in the mainframe horizontal compartment.

2. Connect the signal to be measured to the vertical amplifier input.

3. Press the Display button on the vertical amplifier. (Check that the CAL control is fully clockwise—in its detent.)

4. Set the TRIGGERING controls for a stable display (see General Operating Information for selecting proper triggering).

5. Set the vertical deflection factor and position controls for a vertically centered display with a whole number of divisions of amplitude.

6. Set the TIME/DIV and POSITION controls to display the rising or falling portion of the waveform within the center eight graticule divisions as shown in Figure 2-8 (see General Operating Information in this manual for discussion of timing measurement accuracy).

7. Determine rise time or fall time by measuring the horizontal distance in divisions between the point on the rising or falling portion of the waveform that is 10% and the point that is 90% of the total display amplitude (see Fig. 2-8).

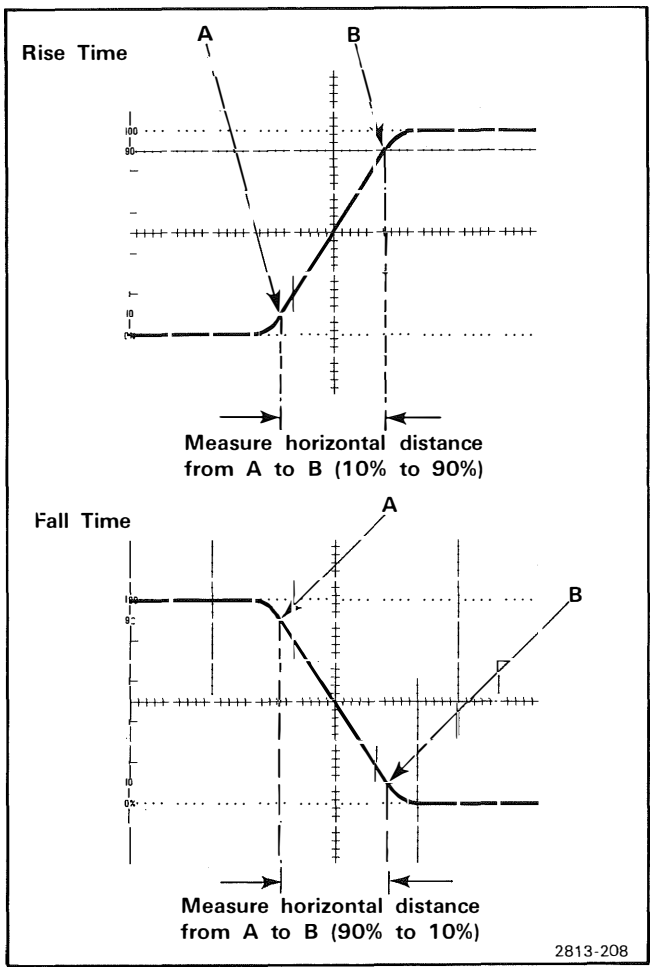



**Figure 2-8. Measuring the rise time and fall time of a pulse.**

**NOTE**

*The oscilloscope graticule is scribed with 0, 10, 90, and 100% lines, labeled at the left edge of the screen, for convenience when measuring rise time or fall time. To use this feature, adjust the vertical deflection factor and position controls to fit the display between the 0 and 100% graticule lines. Then measure the horizontal distance between the points where the waveform crosses the 10% and 90% graticule lines.*

8. Multiply the horizontal distance measured in step 7 by the TIME/DIV setting. (Divide the answer by 10 if sweep magnification is used.)

EXAMPLE: Assume that the horizontal distance between the 10% and 90% amplitude points is 2.5 divisions, and the TIME/DIV setting is 0.1 $\mu$s (see Fig. 2-8).

Using the formula:

$$\text{Rise Time} = \frac{\text{Horizontal distance (divisions)}}{\text{TIME/DIV setting magnification}} \times$$

Substituting values:

Rise time = 2.5 × 0.1 $\mu$s ÷ 1 = 0.25 microsecond

### Pulse-Width

Use this procedure to measure the width of a pulse:

1. Install the 5B25N in the mainframe horizontal compartment.

2. Connect the signal to be measured to the vertical amplifier input.

3. Set the display switches to display the time base and vertical amplifier. (Check that the CAL control is fully clockwise—in its detent.)

4. Set the TRIGGERING controls for a stable display (see General Operating information for selecting proper triggering).

5. Set the vertical deflection factor and position controls for about a five-division pulse vertically centered on the graticule.

6. Set the TIME/DIV and POSITION controls for one complete pulse displayed within the center eight graticule divisions as shown in Figure 2-9.

7. Measure the horizontal distance in divisions between the 50% amplitude points of the displayed pulse (see Fig. 2-9).

8. Multiply the horizontal distance measured in step 7 by the TIME/DIV control setting. (Divide the answer by 10 if sweep magnification is used.)

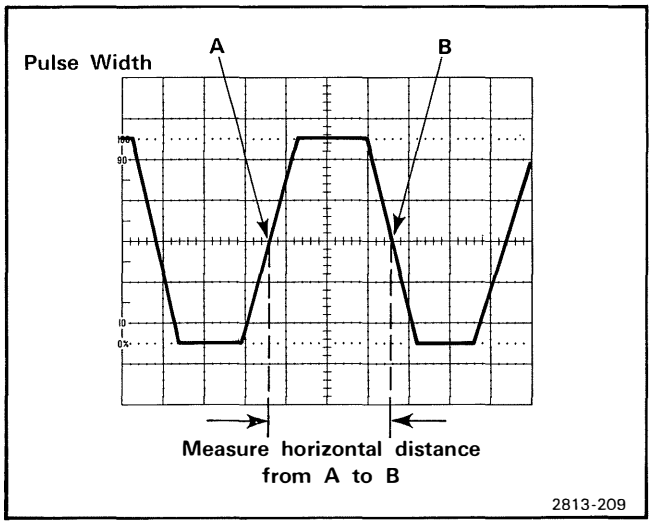



Figure 2-9. Measuring the width of a pulse.

EXAMPLE: Assume that the horizontal distance between the 50% amplitude points is three divisions, and the TIME/DIV control setting is 0.1 ms (see Fig. 2-9).

Using the formula:

$$\text{Pulse Width} = \text{Horizontal Distance} \times \frac{\text{TIME/DIV setting}}{\text{magnification}}$$

Substituting values:

Pulse width = 3 × 0.1 ms ÷ 1 = 0.3 millisecond

## DIGITIZER APPLICATION

### Pretrigger Viewing

In applications where it is desired to view a response to a stimulus, it may be desirable to view the time-window where the stimulus occurred. With conventional triggering methods, the only recourse is to provide an electrical trigger signal coincident with the beginning of the stimulus. This is sometimes impractical with nonelectrical stimuli.

The pretrigger viewing feature lets you observe up to one full digitized sweep length prior to the trigger event. For example, if the sweep rate were set to 100 ms/division, events occurring up to 1 second (10 crt divisions) prior to the trigger point could be observed. Figure 2-10 shows an event viewed at 50% pretrigger. The 50% pretrigger setting puts the trigger point at the horizontal center of the graticule, with pretrigger events as the first half of the display and post-trigger events as the second half.

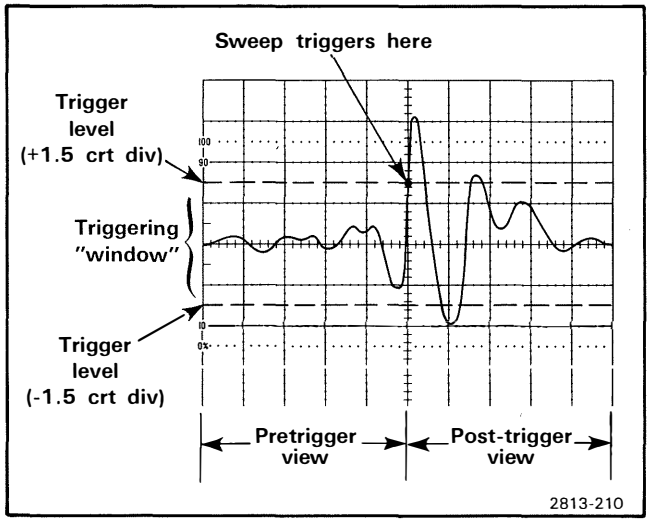



Figure 2-10. Display of signal with bislope triggering, TRIGGERING LEVEL/SENSITIVITY at + and −1.5 crt divisions, and PRETRIGGER set to 50%.



@

One application for the PRETRIGGER control when the time base is installed in the 5223 Digitizing Oscilloscope is to view small transitions in a power supply output prior to loss of that output. Figure 2-11 illustrates how the PRETRIGGER control can be used to locate and study possible fault indications in the output of the supply under test. Triggering on the supply shutdown transition allows the operator to view events prior to shutdown as the PRETRIGGER control is varied from 0% to 100% (up to one full digitized sweep length before the trigger point).

## 5223 Memory Save

The 5223 Memory Save mode may be used to hold and to horizontally and vertically expand the desired portion of the waveform for detailed examination. See the Operating Instructions section of the 5223 Digitizing Oscilloscope manual for more information.

## Bislope Triggering and Capturing Transients of Unknown Polarity

The polarity of an electric signal is not always known in advance. For example, a transient on a power line or the output of a strain gage used for mechanical shock studies could be of either polarity.

If it is important to trigger an oscilloscope (without bislope triggering) on the first major transition, it is necessary to know the polarity of that first transition so the slope and trigger level controls can be set correctly. A wrong setting could cause a lost display. Figure 2-12 shows how a conventional trigger circuit can miss a display if the signal originates with a polarity opposite to the expected polarity.

In the example of Figure 2-12, + slope and a level of +3 crt divisions were the trigger settings. However, the actual signal started out negative-going (solid line) and never reached +3 crt divisions, so the sweep was not triggered and the input was not displayed.

If the trigger level had been set at +1.5 crt divisions, the signal would have triggered the sweep when it reached point 2 in Figure 2-12, but the preceding portion of the waveform would have been lost.

## Bislope Triggering

The 5B25N Digitizer Time Base/Amplifier incorporates bislope triggering, as well as conventional triggering. Bislope triggering guarantees the capture of transient waveforms of unknown polarity by triggering on the first available transition within an adjustable triggering window. Figure 2-13 shows the operation of bislope triggering and a 3.0 division triggering window (+ and −1.5 crt divisions) on the same waveform shown in Figure 2-12.

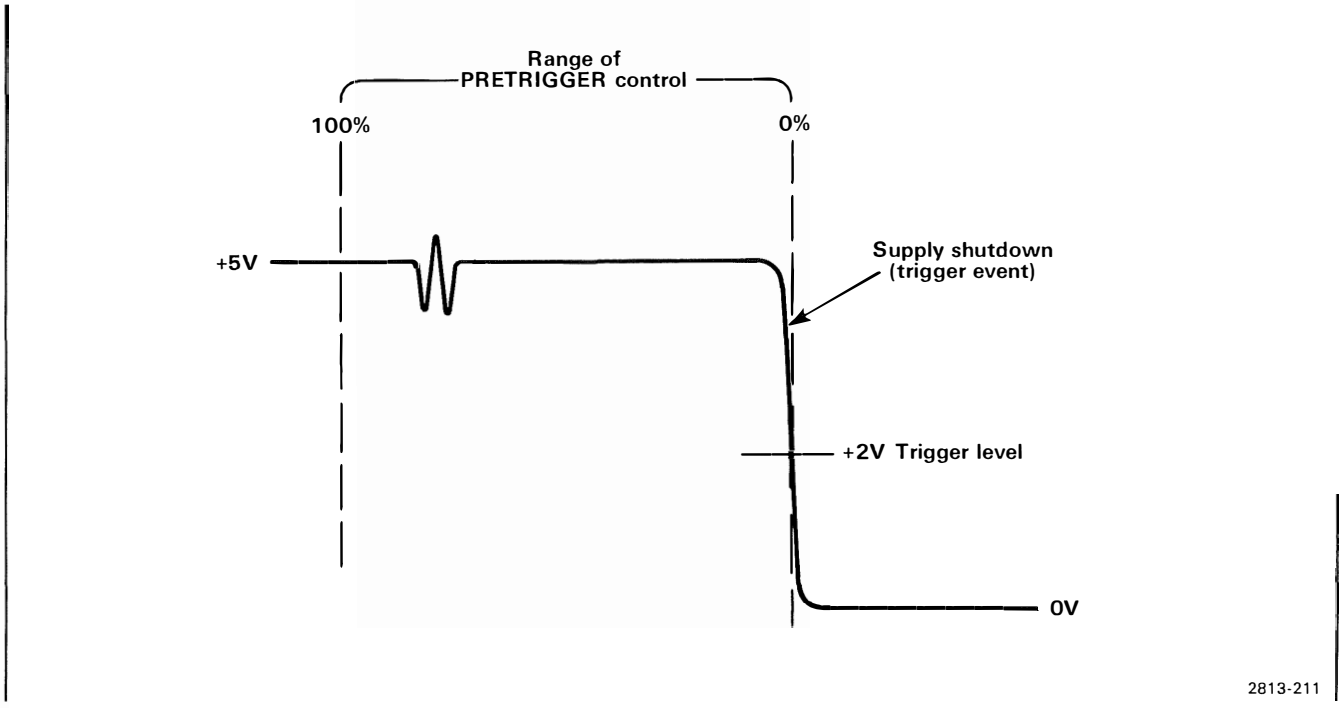



Figure 2-11. Observing power supply variations using the PRETRIGGER control.

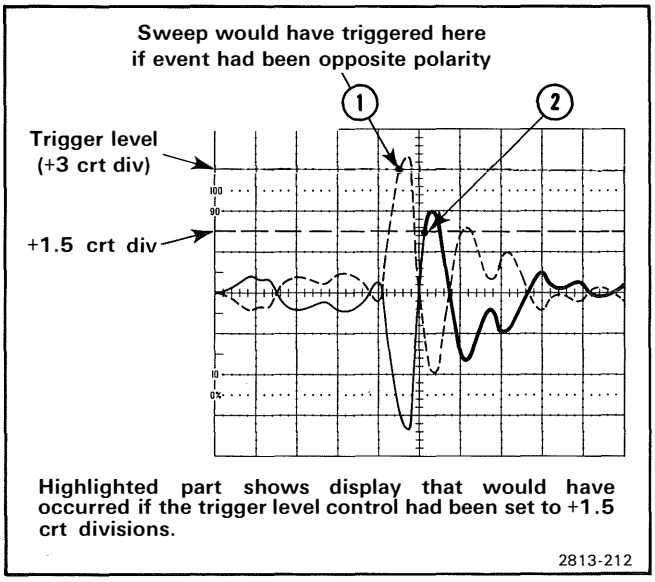



Figure 2-12. Effect of wrong choice of trigger polarity and level for event of random polarity.

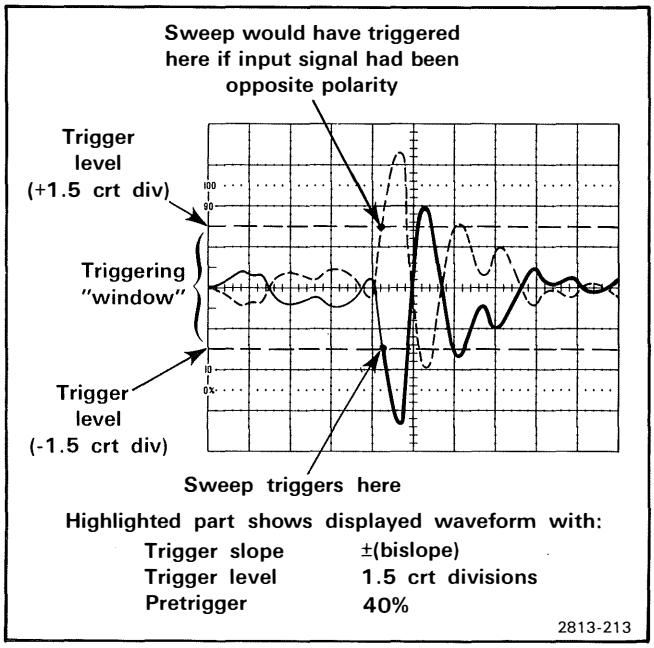



Figure 2-13. Display of same signal using bislope triggering and three-crt-division trigger "window."

## Combined Bislope Triggering & Pretrigger Viewing

The most convenient, reliable way to capture transients of unknown polarity is to use bislope triggering and pretrigger viewing. This ensures that you will see the entire chain of events, regardless of trigger polarity. The actual trigger window is set by the the LEVEL/SENSITIVITY control on the 5B25N. Maximum sensitivity (minimum trigger window) is 1.0 major crt division. The PRETRIGGER control facilitates observation of the leading edge of a waveform at sweep speeds from 5 s to 0.1 ms/division.



@

# THEORY OF OPERATION

This section of the manual describes the circuitry in the 5B25N Digitizer Time Base/Amplifier. The description begins with a discussion of the instrument, using the block diagram shown in Figure 3-1, and then continues in detail, showing the relationships between the stages in each major circuit. Schematics of all major circuits are given in Section 8, Diagrams and Circuit Board Illustrations. Stages are outlined on the schematics with wide shaded lines; the stage names are in shaded boxes. Refer to the appropriate diagram along with the Troubleshooting Chart in section 8 throughout the following discussion.

## BLOCK DIAGRAM

The following discussion presents the overall concept of the 5B25N before the individual circuits are discussed in detail. A basic block diagram of the 5B25N is shown in Figure 3-1. Each major circuit within the instrument is given a block. The numbered diamond in each block refers to the corresponding circuit diagram at the rear of this manual.

## DESCRIPTION

### TRIGGER GENERATOR

The Trigger Generator ensures a stable display by starting each sweep at the same point on the waveform. Circuitry is included for selection of the triggering mode, coupling, and source. The output of the Trigger Generator is a fast-rise pulse which enables the Sweep Generator. The trigger source signal is also fed from the Trigger Generator to the Horizontal Amplifier.

### SWEEP CONTROL

The Sweep Control circuitry controls the 5B25N mode of operation. The Holdoff, Z-Axis, Alternate Drive, and A Gate signals are generated in this block. Holdoff is initiated upon receipt of a Swp End gate from the Sweep Generator. In the NORMAL and SINGLE SWEEP modes Z-Axis, Alternate Drive, and A Gate signals are produced when appropriate trigger gates are present at the Sweep Control inputs. In the AUTO mode these signals occur after a prescribed delay following each sweep, provided no trigger signals are received during the delay.

### SWEEP GENERATOR

The Swp ramp signal starts when the Trigger Generator Gate is applied, via the Sweep Control, to the Sweep Generator. The rate of change (slope) of the ramp is determined by the TIME/DIV control setting. The ramp signal provides horizontal deflection for the oscilloscope mainframe . The Sweep Generator also generates a Swp End gate which initiates holdoff in the Sweep Control block, and a reference voltage for the Clock Generator and Undersampling circuit.

### HORIZONTAL AMPLIFIER

The Horizontal Amplifier has two modes of operation: time-base mode and amplifier mode. In time-base mode, the Horizontal Amplifier changes the sweep ramp to a differential signal for use in the oscilloscope mainframe. In amplifier mode, the external X Signal is fed through the Horizontal Amplifier to the + Plug-In Signal connector. The POSITION and SWP MAG control functions are also provided in this block.

### CLOCK GENERATOR AND UNDERSAMPLING

The circuitry in this block is active only at sweep speeds of 0.1 ms/division and slower. One of the two oscillator outputs is selected and frequency-divided to produce the Real-Time Sample Pulse. The Real-Time Sample Pulse commands the digitizing circuit in the 5223 oscilloscope mainframe to perform an A/D conversion. The POSSIBLE UNDERSAMPLING indicator lights when a logic circuit detects fewer than eight sample pulses between trigger pulses.

### LOGIC

The Logic circuitry generates the $\overline{\text{Sample Pulse}}$ and $\overline{\text{Load Stop}}$ signals. Depending on the operating mode of the 5223 oscilloscope mainframe, the Sample Pulse originates either in the Logic or the Clock Generator and Undersampling block and is fed through the Logic circuitry. The Logic circuit also generates the Sweep Rate signal, which notifies the 5223 which group of sweep speeds is selected and that the time base is a 5B25N.

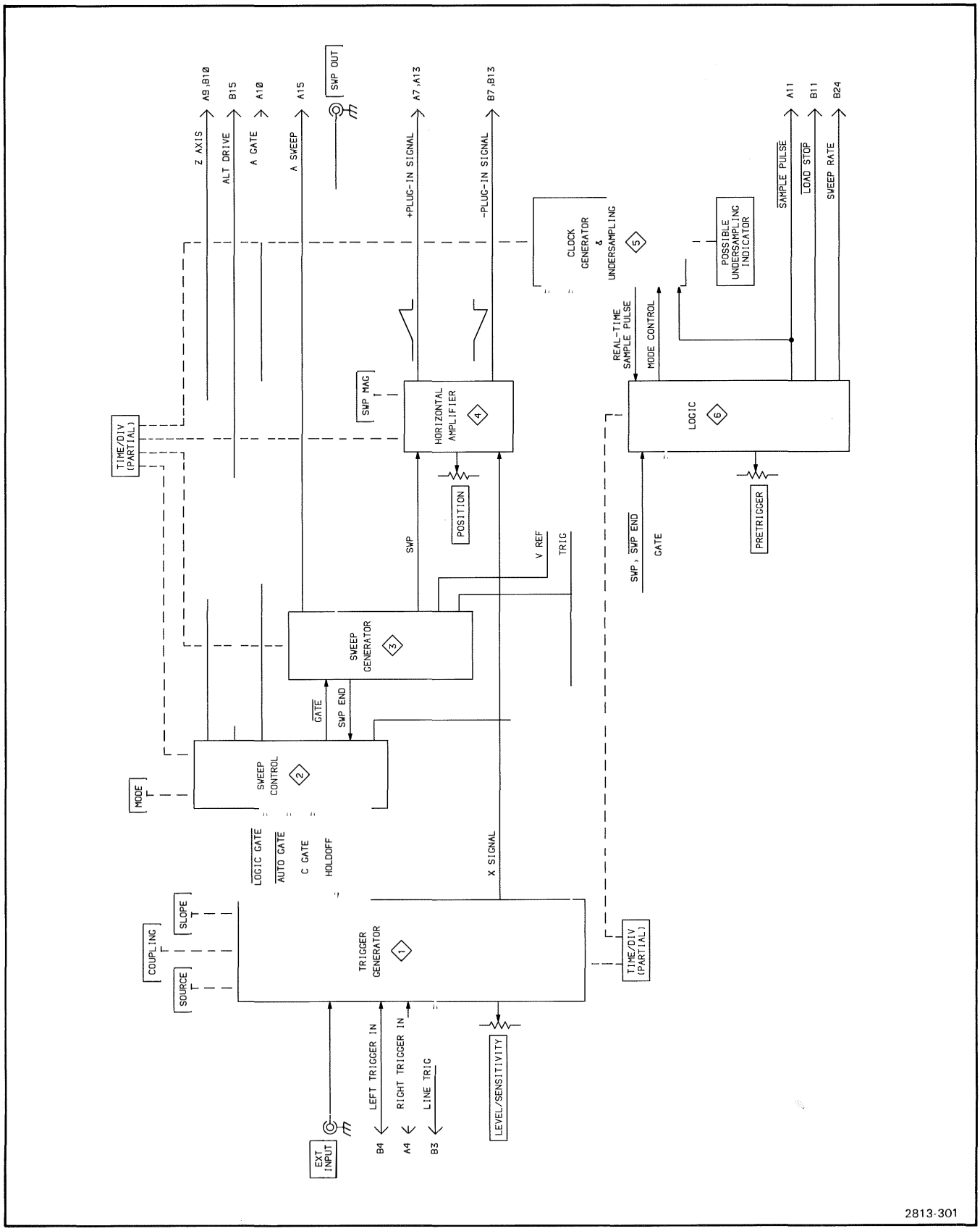



Figure 3-1. Block diagram of the 5B25N Digitizer Time Base/Amplifier.

# DETAILED CIRCUIT OPERATION

Complete schematic diagrams are provided in Section 8, Diagrams and Circuit Board Illustrations. The number inside the diamond preceeding a heading in the following discussions refers to the schematic diagram for that circuit. The schematic diagrams contain wide shaded borders around the major stages of the circuit to conveniently locate the components mentioned in the following discussions. The name of each stage is given in a shaded box on the diagram, and appears as a subheading in the discussion of that schematic diagram.

All logic functions are described using the positive logic convention. Positive logic is a system of notation where the more positive of two levels (HI) is called the true or 1state; the more negative level (LO) is called the false of 0-state. The HI-LO method of notation is used in this logic description. The specific voltages that constitute a HI or LO state vary between individual devices. Whenever possible, the input and output lines are named to indicate the function that they perform when in the HI (true) state.

## 1 TRIGGER

The Trigger Generator provides a stable crt display by starting the Sweep Generator (diagram 3) at a selected point on the input waveform. The triggering point can be varied with the LEVEL/SENSITIVITY control and may be on either the positive- or negative-going portion of the waveform, or both. The triggering source signal may be either the signal being displayed (LEFT, RIGHT), a signal from an external source (EXT), or a sample of the power line voltage (LINE).

### INPUT BUFFER AMPLIFIER

Trigger signals from the left and right vertical compartments in the oscilloscope mainframe pass through the appropriate sections of the TRIGGERING SOURCE switch (S5) to the input of Q20A. Resistors R1 and R3 combine with resistors in the oscilloscope mainframe to provide a signal level of 50 mV/division for the trigger lines. Resistors R5 and R7 are dividers for the sample of ac line voltage used in the line trigger mode. Capacitor C7 acts as a low-pass filter, preventing noise from affecting the triggering. The external input is applied through a compensated attenuator (R9, R10, C10, R16, C16, and C17) to the gate of Q20A when the EXT TRIGGERING SOURCE button is pressed.

Switch S13 provides ac coupling by connecting C12 and C14 to the gate of Q20A in the AC COUPLING control position. The ±Slope Bal control, R29, provides adjustment for zero dc offset through the Input Buffer Amplifier circuit. Field-effect transistor (FET) Q20B is a current source for Q20A.

Diode CR22 protects the gate of FET Q20A from large negative signal excursions. Light-emitting diodes (LED) DS24, DS25 and diodes CR24, CR25 provide over-voltage protection for level comparators U72 and U79. Transistors Q27 and Q32 are thermally coupled (with a common heat sink) to compensate for Q32's base-emitter drop. Emitter-follower Q32 furnishes low-impedance drive to the level comparators and the X Signal input to the Horizontal Amplifier circuit (diagram 4).

### LEVEL COMPARATOR AND SLOPE SELECTOR

Integrated circuits U72 and U79 are voltage comparators which provide signals for use in the Gate Generator circuitry. When the SLOPE control (S11) is in the ± (bislope) position, both comparators are enabled, allowing complementary level comparison to take place. The incoming trigger signal from Q32 is applied to the noninverting and inverting inputs, respectively, of U72 and U79. The opposite input of U72 receives a positive voltage from U62B and the other input of U79 receives a negative voltage from U62A. This arrangement permits complementary voltage control of the comparators with one LEVEL/SENSITIVITY control (R10). Figure 3-2 shows how comparators U72 and U79 respond to a sine-wave trigger signal to help understand the following: The output of U72 goes low when the trigger signal level exceeds the positive threshold level determined by the LEVEL/SENSITIVITY control. Conversely, the output of U79 goes low when the trigger signal level becomes more negative than the threshold level from U62A. Each output goes to a high-logic level again as the trigger signal level recrosses the appropriate threshold levels from U62A and B. Thus, when the sine-wave signal exceeds the positive and negative Sensitivity Threshold levels, the comparators generate output signals. Diodes CR75 and CR82 combine the two signals whose negative-going leading edges are used in the Gate Generator circuit.

The LEVEL/SENSITIVITY control varies the trigger sensitivity threshold in the ± SLOPE mode by shifting the input voltage to U62A and B between about 0 V and a positive level. The input voltage is prevented from reaching exactly 0 volts by R39. If the voltage level reached zero, the threshold level at the comparators would be zero, and the outputs of the comparators would be complements. The complementary signals would cancel each other and produce a steady level at pin 13 of U95 instead of the negative-going edge required by U95. When the TRIGGERING SLOPE switch is set to ± (bislope), Q52 is turned off. The output of Q52 turns off Q47, which produces a high level that turns on switch U45. Integrated circuit U45 holds the junction of R39, R41, and R42 at ground by paralleling FET sections (U45B and D) and injecting a positive offset voltage (U45C).

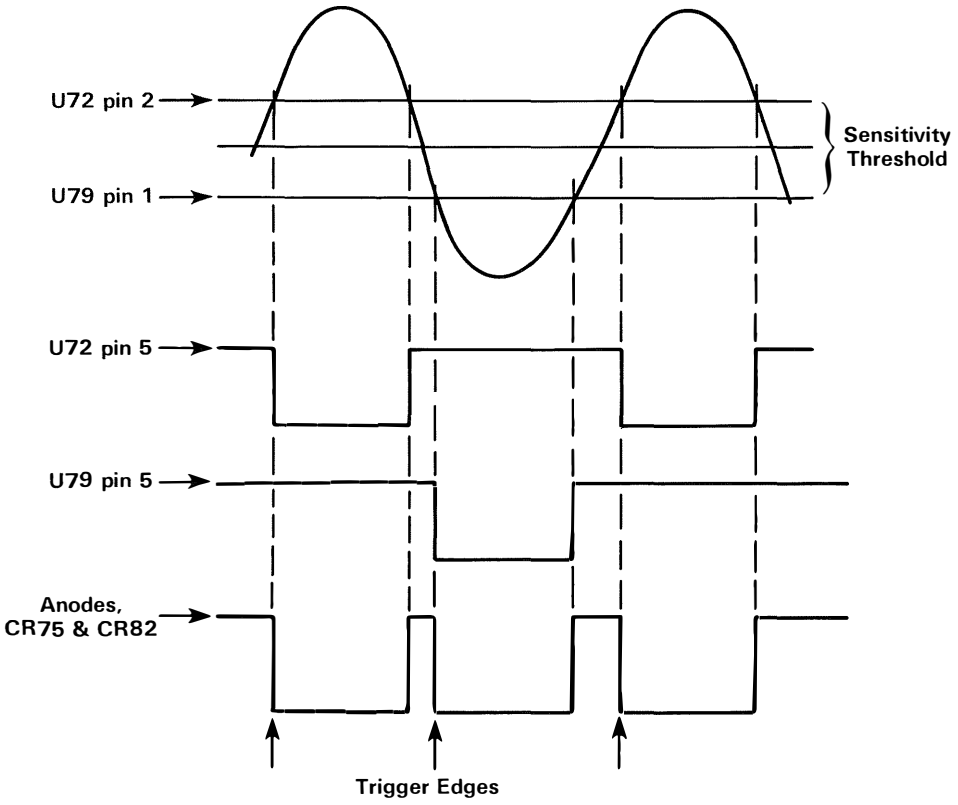



**Figure 3-2. Timing of signals from level comparator with SLOPE in ± (bislope) position.**

Thus, the LEVEL/SENSITIVITY control acts as a unipolar voltage source in the bislope mode only. In the + or – SLOPE control positions U45A, B, C, and D are off, allowing the LEVEL/SENSITIVITY control to function as a bipolar voltage source providing both negative and positive voltage drive to U62.

Setting the SLOPE switch to + or – will disable either U79 or U72 which allows the signal to be triggered on the appropriate slope. When the SLOPE switch is in the – position, U79 produces a trigger signal only when its input goes more negative than the threshold level determined by the LEVEL/SENSITIVITY control. In the + SLOPE position, U72 produces a trigger signal only when its input goes more positive than the threshold level from the LEVEL/SENSITIVITY control. Both U72 and U79 are disabled when the TIME/DIV switch is in the AMPL position. This allows the X Signal from Q32 to drive Q280 (diagram 4) without being affected by the voltage comparators.

Integrated circuit U62A is a unity-gain inverting or noninverting amplifier as selected by U45A. When the SLOPE switch is in the – position, U45A opens and lets U62A operate in its noninverting mode. This allows the trigger level at U79 to become more positive as the LEVEL/SENSITIVITY control is turned clockwise.

## GATE GENERATOR

Integrated circuit U95 receives trigger signals from the level comparators and processes them into gate output signals. It operates like a set-reset flip-flop (FF) by changing its output states (pins 3, 4) every time its input (pin 13) is toggled by a negative-going edge. When pins 6 and 10 go high, the outputs are reset to their original states. Thus, when a trigger signal is present, sweep gating is initiated by U95 and terminated when pins 6 and 10 go high.

Transistors Q95 and Q97 are gate signal comparators which provide level shifting and drive to buffers U98A and B and succeeding circuitry. The gate signal is inverted by U98A and B for use by U135 on diagram 2.


# SWEEP CONTROL

The Sweep Control circuitry provides control of the time base in the AUTO, NORM and SINGLE SWEEP modes depending upon the front-panel control settings. It also provides Holdoff, Z Axis, Alternate Drive, Single-Sweep Mode and A Gate signals for the time base and the oscilloscope mainframe.

Integrated circuit U135 produces an A Gate pulse at pin 7 which is used to start the sweep (diagram 3). In AUTO mode, U135 waits for an interval determined by the RC time constant of C130 and R130 and if no trigger gates are received at pins 5 and 6, it generates an A Gate. Holdoff control is also accomplished by U135. Holdoff starts when a sweep Lockout signal from pins A16 or A17, or a Swp End signal from Q269 (diagram 3), produces a high-logic level at pin 12 of U135. The next Swp Gate is generated after the holdoff interval determined by components at pins 10 and 11.

The pin 7 output of U135 activates U120A, and U98E inverts the U120A output to form the Z Axis signal. The Z Axis signal causes the mainframe to turn off the crt beam during retrace and to turn on the crt beam during the sweep. Figure 3-3 shows these signals, their timing and relation to the crt beam.

When the SINGLE SWEEP RESET button is pressed, the AUTO and NORM modes are disabled. Pushing the RESET button produces a low-logic level at pin 2 of U135, causing U135 to generate a single A Gate pulse if the Logic Gate and Auto Gate lines are at low-logic levels. OR gate U120B directs the A Gate (as $\overline{\text{Gate}}$) from U135 to the Sweep Generator (diagram 3) and other circuitry in the instrument. Gate U120B also couples the fast leading edge of C Gate from Q97 (diagram 1) around U135 to compensate for the slower reaction time required by U135 to generate the A Gate. The fast leading edge of the Swp End pulse from Q269 (diagram 3) is inverted by U98D and combined with the A Gate at U135 pin 7 to speed up its negative-going transition.

## 3 SWEEP GENERATOR

When gated by the Sweep Control circuit (diagram 2), the Sweep Generator produces a linear ramp signal (Swp) for the oscilloscope mainframe. The ramp is fed to the interface connector, the front panel SWP OUT connector, the Horizontal Amplifier (diagram 4), and the Logic circuitry (diagram 6). The Sweep Generator also produces the Swp $\overline{\text{End}}$ gate for the Sweep Control (diagram 2) and Logic (diagram 6) circuitry.

The linear Swp signal is produced by charging a capacitor from a constant-current source. The slope of the ramp determines the sweep rate of the display.

### TIMING CURRENT SOURCE

The Timing Current Source circuitry generates a constant current for the Ramp Generator stage. Integrated circuit U175 establishes a reference voltage ($V_{REF}$) for the timing-current resistors, and for the Clock Generator and the Undersampling circuitry (diagram 5). The Variable TIME/DIV control, R170, varies $V_{REF}$ over a range of greater than 2.5 to 1, providing full control over each sweep speed. Applying $V_{REF}$ to the timing resistors (those connected to U200 pin 2) produces the timing current. Integrated circuit U200 and Q202 form a precision constant-current source. The current entering the summing node at pin 2 of U200 appears at the emitter of Q202. Practically the same current appears at the collector because the alpha of Q202 is very close to unity. The constant timing current is fed to the Ramp Generator stage.

### RAMP GENERATOR

The Ramp Generator stage produces a linear positive-going ramp signal which drives output transistors Q245, Q249 and the Sweep End Comparator stage.

A low-logic level on the $\overline{\text{Gate}}$ line turns off Q214 and Q204, and allows the precision current from Q202 to charge the timing capacitors. Constant current for Q223 and VR233 comes from Q229 and Q241. (The drain of Q223 connects to the emitter of Q260 to provide a constant voltage between its gate and drain and thereby reduce the effects of leakage.)

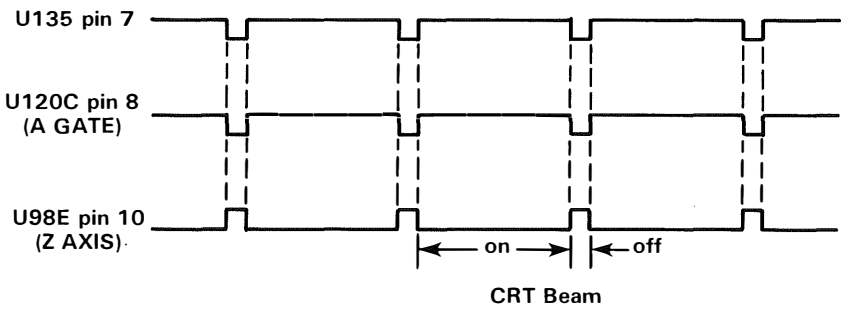



Figure 3-3. Timing of Z AXIS (beam control) signal.

When the sweep ends, the $\overline{\text{Gate}}$ goes to a HI logic level which turns on Q214 and Q204 and discharges the timing capacitors. After the capacitors are discharged, Q204 provides just enough current to offset the current drain into Q202 which results in current equilibrium and stable voltage between sweep ramps (zero volts at the emitter of Q260). Any deviation from this level is detected and compensated by the baseline-stabilization loop comprised of Q223, Q260, Q218, Q214, and Q204. Loop stability is maintained because the bases of Q214 and Q218 attempt to stay close to zero volts. Transistor Q209 and its emitter voltage divider samples a small amount of timing current to compensate for inherent offsets in the stabilization loop. Output emitter-follower stages Q245, Q249, and Q260 isolate the Ramp Generator from, and provide low impedance drive to, the mainframe and succeeding circuitry.

### SWEEP-END COMPARATOR

Transistors Q265 and Q269 form a bistable Schmitt trigger which generates the Swp End pulse. When the sweep ramp reaches about +12 volts, Q265 turns off and Q269 conducts, producing a positive-going pulse at its collector. Inverter U98C sends the pulse, $\overline{\text{Swp End}}$, to the Sweep Control (diagram 2) and to the Logic circuitry (diagram 6).

## 4 HORIZONTAL AMPLIFIER

The Horizontal Amplifier performs four functions: It provides differential sweep signal drive to the plus and minus horizontal oscilloscope mainframe inputs, it amplifies the X Signal from Q32 (diagram 1), it will magnify the sweep rate by 10, and it controls the position of the sweep and X signals.

When the TIME/DIV control is set to any position between 5 s and 0.2 $\mu$s, differential-amplifier pair Q308 and Q338 are active. The amplifier provides differential drive from a single-ended source (Q260, diagram 3) which drives the base of Q338. The overall gain is less than unity. When the X10 SWP MAG button is pressed in, the gain is increased 10 times because R320 and R321 are paralleled with R323 and R325. Transistor Q314 is the current source for Q308 and Q338. Positioning current is applied to the base of Q308 from POSITION control R23.

Setting the TIME/DIV control to the AMPL position disables the sweep-signal differential amplifier and enables the X Signal amplifier. The X signal amplifier is a feedback amplifier. The feedback path is from the collector of Q280 to the collector of Q285, then via R287 to the base of Q295. The output signal at the collector of Q285 is coupled through R309 to the + Plug-In Signal connector. Positioning of the X Signal is provided by the POSITION control via R300.

## 5 CLOCK GENERATOR AND UNDERSAMPLING

The Clock Generator and Undersampling diagram has four distinct groups of circuitry; a crystal oscillator, a voltage-controlled oscillator, a frequency-divider circuit, and a logic circuit that detects possible undersampling. These circuits are active only at sweep speeds of 0.1 ms and slower.

The two oscillators generate pulses which form the Real-Time Sample Pulse when the 5223 is in the real-time sampling mode, i.e., when the 5B25N is set to 0.1 ms/div or a slower sweep speed. (The Real-Time Sample Pulse commands the 5223 Oscilloscope mainframe digitizing circuit to make an A/D conversion.)

The frequency-divider circuit furnishes 100 Real-Time Sample Pulses to the 5223 for each division of unmagnified sweep.

The undersampling detection logic circuit monitors the trigger pulses and sample pulses. When fewer than eight sample pulses occur between trigger pulses, the undersampling detection logic turns on the front-panel POSSIBLE UNDERSAMPLING indicator.

### VOLTAGE-CONTROLLED OSCILLATOR (VCO)

When the variable TIME/DIV control is moved out of the CAL (calibrated) position, the VCO operates and the Crystal Oscillator stops. Both the Crystal Oscillator and the VCO stages are controlled by the Var Gnd line; a low-logic level on the Var Gnd line stops the Crystal Oscillator and allows the VCO to operate and vice versa. The voltage on the $V_{REF}$ line controls the frequency of the VCO. ($V_{REF}$ comes from the variable TIME/DIV control, R170, on diagram 3.)

The VCO is a collector-to-base coupled astable multivibrator. Transistors Q40 and Q43 are the active elements. Two current sources, controlled by $V_{REF}$ via U22, provide charging current for the timing capacitors to set the operating frequency of the VCO. The voltage on the $V_{REF}$ line controls the magnitude of the currents supplied by the current sources, thus controlling the frequency of the VCO.

Because the VCO has no dc feedback paths, Q40 and Q43 could possibly turn on at once. If they did, the VCO would not start. Diodes CR36 and CR37 form an OR gate that senses the voltages at the collectors of Q40 and Q43. As long as the VCO is operating, the OR gate is activated and Q34 is turned on. The output of Q34 is an input to U22, the voltage-control amplifier. If the VCO should stop, the OR gate would be disabled and Q34 would be turned off. The positive voltage at the collector of Q34 would forward-bias CR31 and cause a high-logic level at the + input of U22. Amplifier U22 would respond by turning off the current sources Q25 and Q28, which

would cause Q40 and Q43 to stop conducting. This would generate voltage transients that would start the oscillator.

The output of the VCO goes (via common-base and emitter-follower transistors Q52 and Q54) to U5C, the input of the Frequency-Divider stage.

### CRYSTAL OSCILLATOR

The A and D sections of gate U5, 2 MHz crystal Y8, and associated parts compose the Crystal Oscillator stage. When the variable TIME/DIV control is in its detent (calibrated) position, the Crystal Oscillator operates. Otherwise, the Crystal Oscillator stops because of the low-logic level on the Var Gnd line, and the VCO operates.

The output of the oscillator goes to U5C, the input to the Frequency-Divider stage.

### FREQUENCY DIVIDER

The Frequency Divider stage divides the output of the oscillator to form pulses to trigger the A/D converter on the 5223 Oscilloscope digitizer board. The Frequency Divider stage consists of counter U68, U5C, U88B, U75A & B and related parts.

The oscillator signal reaches counter U68 via U5C. Counter U68 divides its input by 1, 10, 100, 1,000, or 10,000 as determined by the 1, 2, and 3 sections of the TIME/DIV control, S20. Via U88B, the output of U68 reaches FF U75A and B and sections 14, 15 and 16 of S20. Depending up on the setting of S20, the output of counter U68 can be sent directly out, divided by two, or divided by four.

### UNDERSAMPLING DETECTOR

The circuitry on the lower part of diagram 5 lights the front-panel POSSIBLE UNDERSAMPLING indicator when fewer than eight sample pulses occur between successive Trig pulses. The Undersampling Detector circuit consists of U83A, U88A, U86, U90A and Q93.

$\overline{\text{Sample Pulses}}$ from the frequency-divider stage clock the counter, U86. Trig pulses trigger one-shot U83A, whose Q output resets U86 and clocks FF U90A. If a Trig pulse occurs after only two Sample Pulses, the output of one-shot U83A will clock FF U90A and reset counter U86. Flip-flop U90A then applies a HI-logic level to the base of Q93, which conducts current that turns on the POSSIBLE UNDERSAMPLING indicator. If nine Sample Pulses occur without a Trig pulse, the ninth Sample Pulse causes U86 to assert a HI-logic level at its pin 11 output. The HI-logic level from U86 pin 11 has two effects, as follows: 1) It activates U88A, whose LO-logic level output holds FF U90A reset. Now, Trig pulses cannot cause U90A to turn on the POSSIBLE UNDERSAMPLING light. 2) It activates an AND gate in U86 which locks the U86 pin 11 output at a HI-logic level. Counter U86 stays "locked" until a Trig pulse resets it, and it resumes counting.

When the 5B25N is operating in equivalent-time sampling mode (50 $\mu$s/division and faster), the Mode Control line will be at a HI-logic level, activating U88A, holding the U90A reset input at a LO-logic level, and keeping the POSSIBLE UNDERSAMPLING indicator off. When the 5B25N is in the real-time sampling mode (0.1 ms/division and slower), the Mode Control line will be at a LO-logic level, permitting U88A to respond to the output of U86.

## LOGIC

The circuitry on the Logic diagram generates $\overline{\text{Sample Pulse}}$ and Load Stop signals. The Logic circuit consists of a counter, U103, U105, and U107; a D/A converter, U109; a comparator, U142 and U70D; multiplexers, U155A and B; a one-shot multivibrator, U83B; and associated circuitry.

**NOTE**

*The Logic circuit operation is more easily described by discussing how it produces its output signals, rather than by discussing individual stages. For this reason the Logic circuit description subheadings are given signal names rather than stage names.*

### $\overline{\text{SAMPLE PULSE}}$

#### Equivalent-Time Sampling (50 $\mu$s/division and faster)

In this mode comparator U142 produces an output (which becomes the $\overline{\text{Sample Pulse}}$) when the combined voltage of the sweep and the output of D/A converter U109 crosses zero volts. The output of U142 increments counter U103, U105 and U107, which then presents a higher number to U109. D/A converter U109 then produces a slightly higher output voltage, which combines with the next sweep to cause the next $\overline{\text{Sample Pulse}}$ at a later time. Because only one $\overline{\text{Sample Pulse}}$ occurs per sweep, 1024 sweeps must occur to sample an entire display. Each time the sweep triggers comparator U142, U70D activates U70B. The output of U70B reaches the inputs of multiplexer U155B via U101C, S20 section 24, and S29. It reaches one input (U155B pins 9 and 10) directly and the other (U155B pin 12) via a differentiator. The Mode Control line, and its complement, control the two input gates in U155B. Switch S20 section 13 establishes the voltage on the Mode Control line—it will be a HI-logic level when the TIME/DIV control is set to 50 $\mu$s or faster (equivalent-time sampling), and a LO-logic level when the TIME/DIV control is at 0.1 ms or slower (real-time sampling). When the Mode Control line is at a HI-logic level it enables U155B at its pin 11 input, and the direct input from U70B activates U155B to produce the Sample Pulse. The Sample Pulse starts when the sweep triggers U142 and ends at the end of the sweep when U142 resets.

## Real-Time Sampling (.1 ms/division and slower)

When the 5223 Oscilloscope mainframe is operating in the real-time sampling mode and the SAMPLE CLK SOURCE button is in NORMAL position (pressed in), Sample Pulses are caused by the Real Time Sample Pulse from the frequency-divider circuit shown on diagram 5. Real Time Sample Pulses reach multiplexer U155B via section 23 of S20, and S170B. In the real-time sampling mode, section 24 of S20 disconnects the counter, the D/A converter and comparator circuits from multiplexer U155. A LO-logic level on the Mode Control line disables U155B pin 11; its complement enables U155B pins 1 and 13. Capacitor C77 and the combination of R78 and R79 differentiate the Real Time Sample Pulse. The resulting positive spike activates U155B to produce a short (between 50 and 100 ns) Sample Pulse. Table 3-1 shows the relation between the TIME/DIV control setting and the SAMPLE PULSE.

TABLE 3-1
Relationship of TIME/DIV Control, Counter U68, and SAMPLE PULSE in Real-Time Sampling Mode

| TIME/DIV | Output of Counter U68 | SAMPLE PULSE Frequency | SAMPLE PULSE Period |
|---|---|---|---|
| 5 s | 20 Hz | 20 Hz | 50 ms |
| 2 s | 200 Hz | 50 Hz | 20 ms |
| 1 s | | 100 Hz | 10 ms |
| .5 s | | 200 Hz | 5 ms |
| .2 s | 2 kHz | 500 Hz | 2 ms |
| .1 s | | 1 kHz | 1 ms |
| 50 ms | | 2 kHz | .5 ms |
| 20 ms | 20 kHz | 5 kHz | .2 ms |
| 10 ms | | 10 kHz | .1 ms |
| 5 ms | | 20 kHz | 50 μs |
| 2 ms | 200 kHz | 50 kHz | 20 μs |
| 1 ms | | 100 kHz | 10 μs |
| .5 ms | | 200 kHz | 5 μs |
| .2 ms | 2 MHz | 500 kHz | 2 μs |
| .1 ms | 2 MHz | 1 MHz | 1 μs |

## LOAD STOP

Equivalent-Time Sampling (50 μs/division and faster)

In equivalent-time sampling mode U83B generates one Load Stop pulse for every 1024 Sample Pulses. A HI-logic level on the Mode Control line enables the gate on U155A pin 4. A LO-logic level activates the gate on U155A pin 2. The pin 8 output of counter U107 is at a LO-logic level from sweeps zero to 511, and at a HI-logic level from sweeps 512 to 1023. Multiplexer U155A inverts this signal and appies it to the D input (pin 12) of FF U90B. At sweep 1023 the D input of FF U90B receives a HI-logic level and the clock input receives the inverted Sample Pulse via U88C. Flip-flop U90B produces a positive-going output that triggers one-shot U83B to produce the Load Stop pulse. Figure 3-4 shows the timing of these events.

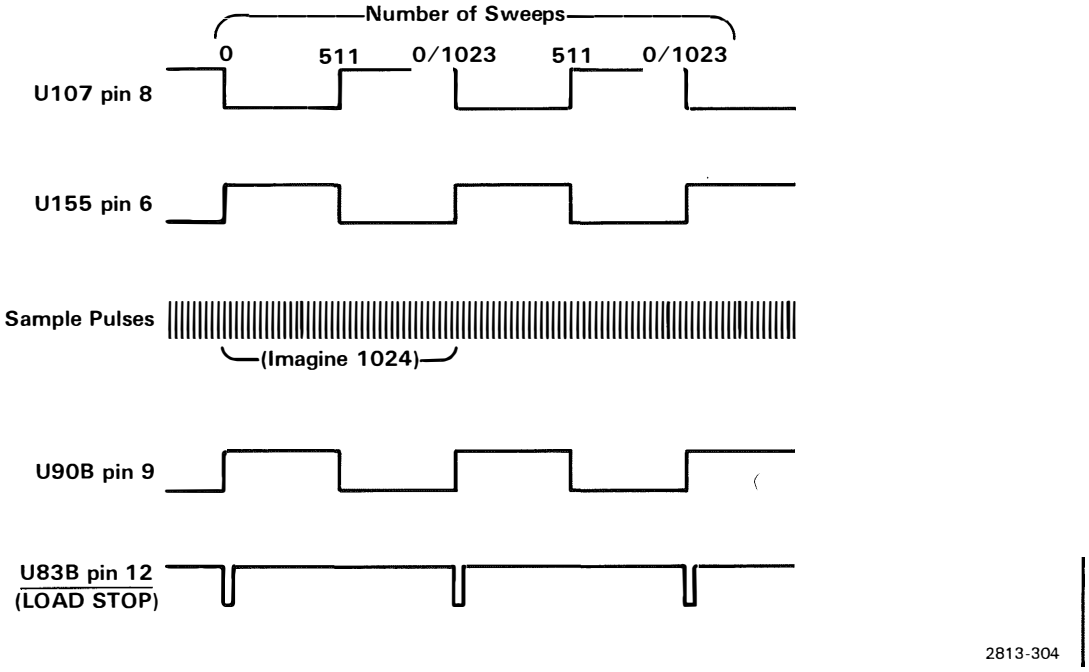



Figure 3-4. Timing of LOAD STOP pulse.

In the equivalent-time sampling mode, if U142 does not generate a sample pulse during the sweep due to improper adjustment of the Sample Zero or Sample FS controls (R133 or R115), U70B will produce one when it receives a Swp End pulse.

### Real-Time Sampling (.1 ms/division and slower)

In real-time sampling mode, comparator U142 produces a pulse (which becomes Load Stop) when the combined voltage of the sweep and the output of Q123 crosses zero volts. The setting of the PRETRIGGER control, R341, sets the conduction of Q123. This permits the operator to set the Load Stop pulse anywhere in the sweep. When U142 is triggered it activates U70D, whose output activates U70B. Gate U70B activates U88D, which applies a LO-logic level to pin 3 of multiplexer U155A. In real-time sampling mode a HI-logic level on pin 2 enables U155A, and U88D's output activates U155A. The HI-logic level output of U155A is connected to the D input (pin 12) of FF U90B. The next Sample Pulse clocks FF U90B (via U88C) and the U90B output triggers one-shot U83B. One-shot U83B produces the Load Stop pulse, which is about 1 $\mu$s in duration. The Gate line controls comparator U142 and U70D—a HI-logic level enables them during the sweep, and a LO-logic level disables them during holdoff time.

If the PRETRIGGER control is set for the display to end more than 1024 samples after the sweep start, the trigger event would be off screen when viewing the stored display, and no Load Stop pulse would occur. To ensure that this doesn't happen, the $Q_D$ output of U107 is connected to U88D. This connection causes multiplexer U155A to generate a $\overline{\text{Load Stop}}$ pulse 1024 samples after the beginning of the sweep if U142 has not previously done so. If the PRETRIGGER control is set to a level that means "before sweep start," U142 will be held off by the Gate signal until sweep start, when it will change states.

When the TIME/DIV control is in the AMPL position, the 5B25N operates as an amplifier. To notify the 5223 mainframe of this, S20 contact 4 opens and allows the Sweep Rate line to float.

# MAINTENANCE

This section of the manual contains information for performing preventive maintenance, troubleshooting, and corrective maintenance for the 5B25N.

## PREVENTIVE MAINTENANCE

Preventive maintenance consists of cleaning, visual inspection, lubrication, etc. Preventive maintenance, performed regularly, may prevent instrument breakdown and will improve the reliability of the instrument. The severity of the environment to which this instrument is subjected determines the frequency of maintenance. A convenient time to perform preventive maintenance is preceding electrical adjustment of the instrument.

### CLEANING

The 5B25N should be cleaned as often as operating conditions require. Accumulation of dirt on components acts as an insulating blanket and prevents efficient heat dissipation which can cause overheating and component breakdown.

**CAUTION**

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

#### EXTERIOR

Loose dust accumulated on the front panel can be removed with a soft cloth or small brush. Dirt that remains can be removed with a soft cloth dampened with a mild detergent and water solution. Do not use abrasive cleaners.

**WARNING**

*To avoid electric shock, disconnect the instrument from the power source before removing protective panels.*

#### INTERIOR

Dust in the interior of the instrument 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 which remains with a soft brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces.

#### SWITCH CONTACTS

Switch contacts and pads are designed to operate dry. However, as the switches are not sealed, dust attracted to the contact area may cause switch contacts to become electrically noisy. Cleaning may be accomplished by flushing the contact area with isopropl alcohol or a kelite solution (1 part kelite to 20 parts water). Do not use chemical cleaning agents that leave a film or that might damage plastic parts. Do not use cotton swabs or similar applicators to apply cleaning agents, as they tend to snag and leave strands of cotton on switch contacts. Should it become necessary to remove a switch for replacement or cleaning, refer to Component Removal and Replacement in this section.

### VISUAL INSPECTION

Inspect the 5B25N occasionally for such defects as broken connections, improperly seated semiconductors, 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 parts 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.

## LUBRICATION

Generally, there are no parts in this instrument that require a regular lubrication program during the life of the instrument.

### CAM SWITCH LUBRICATION

In most cases, factory lubrication should be adequate for the life of the instrument. However, if the switch has been disassembled for replacement of switch sub-parts, a lubrication kit containing the necessary lubricating materials and instruction is available through any Tektronix Field Office. Order Tektronix Part 003-0342-01. General Electric Versilube™ silicone grease should be applied sparingly so that the lubricant does not get on the contacts. Refer to Figure 4-1 for lubrication instructions.

## SEMICONDUCTOR CHECKS

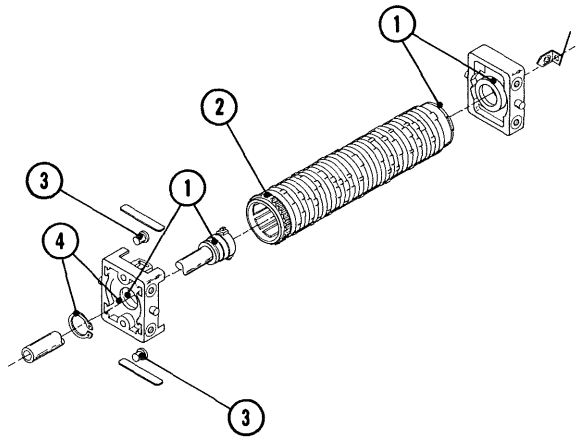
Periodic checks of the semiconductors in this instrument are not recommended. The best check of semiconductor performance is actual operation in the instrument. More details on checking semiconductor operation are given under Troubleshooting.

## ADJUSTMENT AFTER REPAIR

After any electrical component has been replaced, the adjustment of that particular circuit should be checked, as well as the adjustment of other closely related circuits. The Performance Check procedure in this manual provides a quick and convenient means of checking instrument operation. In some cases, minor troubles may be revealed or corrected by adjustment.

## ELECTRICAL ADJUSTMENT

To ensure accurate measurements, check the electrical adjustment of this instrument after each 1000 hours of operation, or every six months if used infrequently. In addition, replacement of components may necessitate adjustment of the affected circuits. Complete adjustment instructions are given in Section 5, Calibration. This procedure can be helpful in localizing certain troubles in the instrument, and in some cases, may correct them.




(1) Apply lubricant to the drum journals and mating surface in the mounting bearings.

(2) Apply lubricant to the wear surface of the index wheel.

(3) Apply lubricant to the index roller and roller guide in the front bearing. A thin film should be applied to the inner face of the detent springs if more than one spring is replaced.

(4) Ensure that some lubricant is present at the interface between the bearing and retainer clip.

2813-401

**Figure 4-1. How to lubricate a cam switch.**

# TROUBLESHOOTING

The following information is provided to facilitate troubleshooting the 5B25N. Information in other sections of this manual should be used in conjunction with the following data to aid in locating a defective component. An understanding of the circuit operation is helpful in locating troubles. See Section 3, Theory of Operation, for this information.

## TROUBLESHOOTING AIDS

### DIAGRAMS

Complete schematic diagrams are provided on the foldout pages in Section 8, Diagrams and Circuit Board Illustrations. The component number and electrical value of each component in this instrument are shown on these diagrams. (See the first page of the Diagrams and Circuit Board Illustrations section for definitions of the reference designators and symbols used to identify components in this instrument.) Important voltages and numbered waveform test points are also shown on the diagrams. Important waveforms, and the numbered test points where they were obtained, are located adjacent to each diagram. Each schematic diagram is divided into functional blocks, indicated by wide shaded lines. These functional blocks are described in detail in Section 3, Theory of Operation.

## CIRCUIT-BOARD ILLUSTRATIONS

Illustrations of the circuit boards appear on the backs of the foldout pages facing the schematic diagrams. The illustrations show the location of the components and waveform test points that appear on the schematic diagram. The circuit-board illustrations are arranged in a grid locator with an index to facilitate rapid location of parts.

## TEST POINT AND ADJUSTMENT LOCATIONS

To aid in locating test points and adjustable components called out in the Performance Check and Adjustment procedures, a Test Point and Adjustment Locations foldout page is provided in Section 8, Diagrams and Circuit Board Illustrations.

## SWITCH CAM IDENTIFICATION

Switch cam numbers shown on diagrams indicate the position of each cam in the complete switch assembly. The switch cams are numbered from front to rear.

## DIODE COLOR CODE

The cathode end of each glass-encased diode is indicated by a stripe, a series of stripes, or a dot. The cathode and anode ends of metal-encased diodes are identified by the diode symbol marked on the case. For most silicon or germanium diodes with a series of stripes, the color code code identifies the four significant digits of the JEDEC or vendor number using the resistor color-code system (e.g., a diode color-coded yellow-brown green-red indicates a 1N-4152 diode).

## COMPONENT COLOR CODING

This instrument contains composition resistors, metal-film resistors, carbon-film resistors and wire-wound resistors. The resistance values of wire-wound resistors are usually printed on the component body. The resistance values of composition resistors and metal-film resistors are color coded on the components using the EIA color code (some metal-film resistors may have the value printed on the body). The color code is read starting with the stripe nearer the end of the resistor. Carbon film and composition resistors have four stripes, which consist of two significant figures, a multiplier, and a tolerance value (see Fig. 4-2). Metal-film resistors have five stripes consisting of three significant figures, a multiplier, and a tolerance value.

The values of common ceramic capacitors and small electrolytics are marked on the side of the component body. The white ceramic and epoxy-coated tantalum capacitors used in the instrument are color coded using a modified EIA code (see Fig. 4-2). Axial capacitors either have a value printed on the body or use the modified EIA code.

The cathode end of glass-encased diodes is indicated by a stripe, a series of stripes, or a dot. The cathode and anode ends of metal-encased diodes can be identified by the diode symbol marked on the body.

## SEMICONDUCTOR LEAD CONFIGURATIONS

Figure 4-3 shows the lead configurations of semiconductors used in the 5B25N.

## STATIC-SENSITIVE DEVICES

**CAUTION**

*Static discharge can damage any semiconductor component in this instrument.*

This instrument contains electrical components that are susceptible to damage from static discharge. See Table 4-1 for relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

**TABLE 4-1**
**Relative Susceptibility to Damage from Static Discharge**

| Semiconductor Classes | Relative Susceptibility Levels[1] |
|---|---|
| MOS or CMOS microcircuits or discretes, or linear microcircuits with MOS inputs (most sensitive) | 1 |
| ECL | 2 |
| Schottky signal diodes | 3 |
| Schottky TTL | 4 |
| High-frequency bipolar transistors | 5 |
| JFETs | 6 |
| Linear Microcircuits | 7 |
| Low-power Schottky TTL | 8 |
| TTL (least sensitive) | 9 |

[1] **Voltage equivalent for levels.**

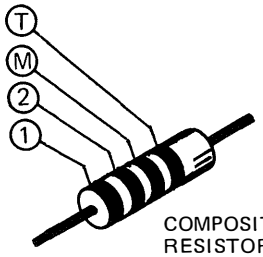
**1 = 100 to 500 V**
**2 = 200 to 500 V**
**3 = 250 V**
**4 = 500 V**
**5 = 400 to 600 V**
**6 = 600 to 800 V**
**7 = 400 to 1000 V (est.)**
**8 = 900 V**
**9 = 1200 V**

**(Voltage dischared from a 100 pF capacitor through a resistance of 100 ohms).**

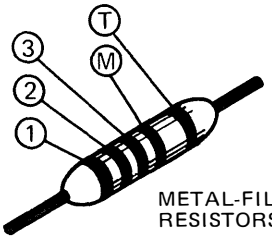
## COLOR CODE

(1) (2) and (3) - 1ST, 2ND, AND 3RD SIGNIFICANT FIGS.
(M) - MULTIPLIER (T) - TOLERANCE;
(TC) - TEMPERATURE COEFFICIENT.

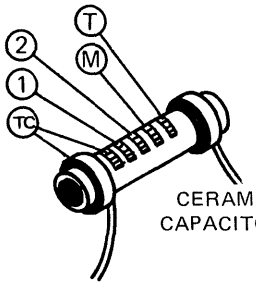
(T) AND/OR (TC) COLOR CODE MAY NOT BE PRESENT ON SOME CAPACITORS;
(P) - POLARITY AND VOLTAGE RATING



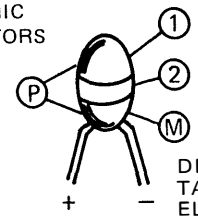

COMPOSITION RESISTORS




METAL-FILM RESISTORS




CERAMIC CAPACITORS




DIPPED TANTALUM ELECTROLYTICS

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

C1862-74

**Figure 4-2. Color codes for resistors and capacitors.**

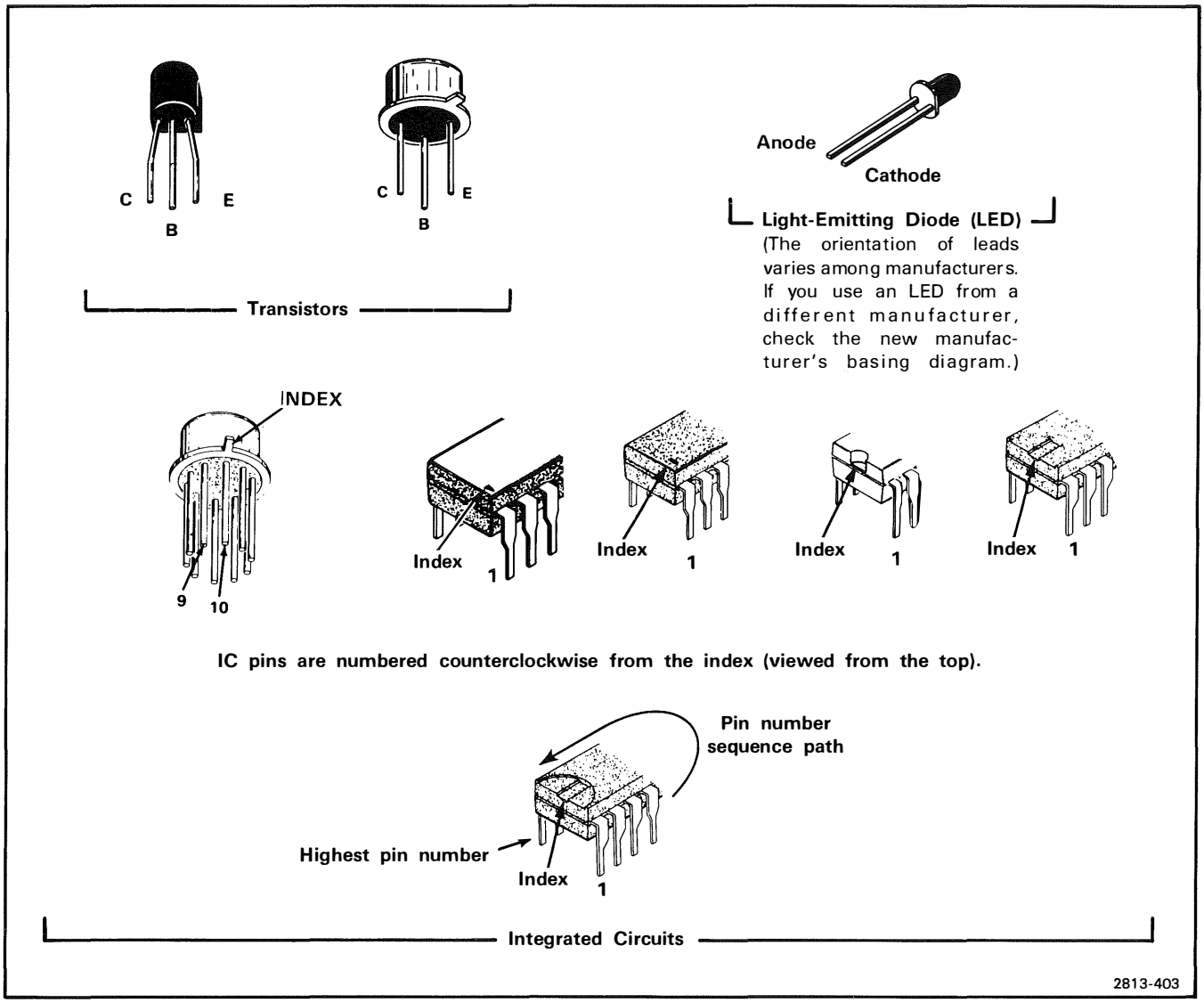



**Figure 4-3. Semiconductor lead configurations.**

## STATIC SENSITIVE DEVICES (CONT)

Observe the following precautions to avoid damage:

1. Minimize handling of static-sensitive components.

2. Transport and store static-sensitive components or assemblies in their original containers, on a metal rail, or on conductive foam. Label any package that contains static-sensitive assemblies or components.

3. Discharge the static voltage from your body by wearing a wrist strap while handling these components. Servicing static-sensitive assemblies or components should be performed only at a static-free work station by qualified service personnel.

4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.

5. Keep the component leads shorted together whenever possible.

6. Pick up components by the body, never by the leads.

7. Do not slide the components over any surface.

8. Avoid handling components in areas that have a floor or work-surface covering capable of generating a static charge.

9. Use a soldering iron that is connected to earth ground.

10. Use only special antistatic suction-type desoldering tools.

## MULTI-PIN CONNECTOR HOLDERS

The multi-pin connector holders are keyed with two triangles, one on the holder and one on the circuit board.

The two triangles identify pin 1 of the holder and the row of pins. When connecting a holder to its row of pins, orient the holder so that triangles align (see Fig. 4-4).

## TROUBLESHOOTING EQUIPMENT

The following equipment, in addition to that listed in Section 5, Calibration, is useful for troubleshooting the 5B25N.

Semiconductor Tester

**Description:** Dynamic-type tester.

**Purpose:** To test the semiconductors used in the 5B25N.

**Recommended Type:** TEKTRONIX Type 576 Curve Tracer or equivalent.

Multimeter

**Description:** Ten-megohm input impedance and 0 to 300 volts range, ac and dc; ohmmeter, 0 to 50 megohms; accuracy, within 3%. Test probes must be insulated to prevent accidental shorting.

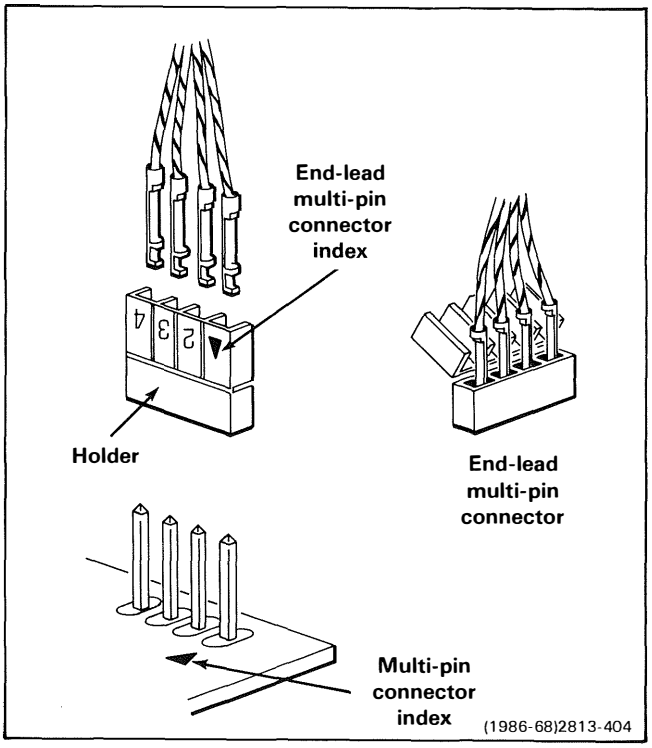



**Figure 4-4. Orientation of multi-pin connector holders.**

Test Oscilloscope

**Description:** Frequency response, 0 to 50 MHz; deflection factor, one millivolt/division to five volts/division. Use a 10X, ten-megohm voltage probe to reduce circuit loading for voltage measurements.

**Purpose:** To check operating waveforms.

# TROUBLESHOOTING TECHNIQUES

This troubleshooting procedure is arranged in an order that checks the simple trouble possibilities before proceeding with extensive troubleshooting. The first few checks ensure proper connection, operation, and adjustment. If the trouble is located by these checks, the remaining steps aid in locating the defective component. When the defective component is located, replace it using the replacement procedure given under Component Replacement in this section.

## 1. CHECK CONTROL SETTINGS

Incorrect control settings can indicate a trouble that does not exist. If there is any question about the correct function or operation of any control on the 5B25N, refer to Section 2, Operating Information.

## 2. CHECK ASSOCIATED EQUIPMENT

Before proceeding with troubleshooting, check that the equipment used with this instrument is operating correctly. Also, check that the input signals are properly connected and that the interconnecting cables are not defective. Check the power source voltages.

## 3. VISUAL CHECK

Visually check that part of the instrument where the trouble is located. Many troubles can be found by visible indications, such as unsoldered connections, broken wires, damaged circuit boards and damaged components.

## 4. CHECK INSTRUMENT ADJUSTMENT

Check the electrical adjustment of this instrument, or of the affected circuit if the trouble appears in one circuit. The apparent trouble may be a result of misadjustment. Complete adjustment instructions are given in Section 5, Calibration.

## 5. ISOLATE TROUBLE TO A CIRCUIT

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

Incorrect operation of all circuits often indicates trouble in the power supplies. Check first for a correct output voltage of the individual supplies. A defective component elsewhere in the instrument can appear as a power-supply trouble and may also affect the operation of other circuits. Refer to the manual for the mainframe in use for its particular voltage ranges and ripple values. These voltages are measured between the power-supply test points and ground (see the Test Point and Adjustment Locations foldout page in Section 8, Diagrams and Circuit Board Illustration, for test-point locations). If the power-supply voltages and ripple are within the listed ranges, the supply can be assumed to be working correctly. If they are outside the range, the supply may be misadjusted or operating incorrectly. To adjust the power supplies, use the procedure given in the Calibration section of the mainframe manual.

## 6. CHECK VOLTAGES AND WAVEFORMS

Often the defective components can be located by checking for the correct voltages or waveforms in the circuit. Typical voltages and waveforms are given in Section 8, Diagrams and Circuit Board Illustration.

**NOTE**

*Voltages and waveforms given in Section 8, Diagrams and Circuit Board Illustrations, are not absolute and may vary slightly between instruments. To obtain operating conditions similar to those used to make these readings, see the list of set-up conditions.*

## 7. CHECK INDIVIDUAL COMPONENTS

The following procedures describe methods of checking individual components in the 5B25N. Components which are soldered in place are best checked by first disconnecting one end. This isolates the measurement from the effects of surrounding circuitry.

**WARNING**

*To avoid electrical shock, always unplug the 5B25N from the mainfame before replacing components.*

### Transistors

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

### Integrated Circuits

Integrated circuits can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good undestanding of the circuit operation is essential when troubleshooting circuits that contain integrated circuits. Use care when checking voltages and waveforms around the integrated circuits so that adjacent leads are not shorted together. An integrated-circuit test clip provides a convenient means of clipping a probe to in-line multi-pin integrated circuits. This test clip also doubles as an integrated-circuit extraction tool.

### Diodes

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

**CAUTION**

*When checking diodes, do not use an ohmmeter scale that has a high internal current because high currents may damage the diodes under test.*

### Resistors

Check resistors with an ohmmeter. Resistor tolerance is given in Section 7, Replaceable Electrical Parts. Normally, resistors need not be replaced unless the measured value varies widely from the specified value.

### Capacitors

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

## 8. REPAIR AND READJUST THE CIRCUIT

If any defective parts are located, follow the replacement procedures given under Removing and Replacing Parts in this section. Check the performance of any circuit that has been repaired or that has had any electrical components replaced. Adjustment of the circuit may be necessary.

# CORRECTIVE MAINTENANCE

Corrective maintenance consists of component replacement and instrument repair. Special techniques required to replace components in the 5B25N are given here.

## OBTAINING REPLACEMENT PARTS

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

**NOTE**

*When selecting replacement parts, remember that the physical size and shape of a component may affect its performance in the instrument. All replacement parts should be direct replacements unless you know that a different component will not adversely affect instrument performance.*

### SPECIAL PARTS

Some components of the 5B25N are manufactured or selected by Tektronix, Inc. to meet specific performance requirements. Most of the mechanical parts used in this instrument were manufactured by Tektronix, Inc. Order all special parts directly from your local Tektronix Field Office or representative.

### ORDERING PARTS

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

1. Instrument type.

2. Instrument serial number.

3. A description of the part (if electrical, include the circuit number).

4. Tektronix part number.

## SOLDERING TECHNIQUES

**WARNING**

*To avoid electric shock, unplug the 5B25N from the mainframe before soldering.*

The reliability and accuracy of this instrument can be maintained only if proper soldering techniques are used when repairing or replacing parts. General soldering techniques which apply to maintenance of any precision electronic equipment should be used when working on this instrument. Use only 60/40 resin-core, electronic-grade solder. The choice of soldering iron is determined by the repair to be made. When soldering on circuit boards or small wiring, use only a 15-watt, pencil-type soldering iron. A higher-wattage soldering iron can cause the etched circuit wiring to separate from the base material and melt the insulation from small wiring. Always keep the soldering-iron tip properly tinned to ensure the best heat transfer to the solder joint. Apply only enough heat to remove the component or to make a good solder joint. To protect heat-sensitive components, hold the component lead with a pair of long-nose pliers between the component body and the solder joint. Use a solder-removing wick to remove excessive solder from connections or to clean circuit board pads.

The following technique should be used to replace a component on any of the circuit boards in this instrument. Most components can be replaced without removing the board(s) from the instrument.

1. Touch the soldering iron to the lead at the solder connection. Never place the iron directly on the board.

2. Melt a small amount of solder onto the component lead connection. This replaces the flux, which may have been removed during instrument cleaning, and facilitates removal of the component.

3. Grip the component lead with a pair of long-nose pliers. When the solder begins to flow, gently pull the component lead from the board. If unable to separate the lead from the board, try removing the other end of the component.

**NOTE**

*Some components are difficult to remove from the circuit board due to a bend placed in each lead during machine insertion of the component. (The bent leads hold the component in position during a flow-solder manufacturing process which solders all components at once.) To make removal of machine-inserted components easier, straighten the leads of the component on the back of the circuit board using a small screwdriver or pliers, while heating the soldered connection.*

4. Bend the leads of the replacement component to fit the holes in the circuit board. If the component is replaced while the board is mounted in the instrument, cut the leads so they will just protrude through the board. Insert the leads into the holes in the board so that the component is firmly seated against the board, or as originally positioned.

5. Touch the iron to the connection and apply enough solder to make a firm solder joint.

6. Cut off any excess lead protruding through the board (if not clipped in step 4).

7. Clean the area around the solder connection with a flux-removing solvent. Be careful not to remove information printed on the circuit board.

## REMOVING AND REPLACING PARTS

**WARNING**

*To avoid electric shock, always unplug the 5B25N from the mainframe before replacing components.*

The exploded-view drawings associated with the Replaceable Mechanical Parts list (located at the rear of this manual) may be helpful in the removal or disassembly of individual components or sub-assemblies.

### CIRCUIT BOARDS

If a circuit board is damaged beyond repair, the entire assembly, including all soldered-on components, can be replaced. Figure 4-5 shows circuit board locations. The part numbers for the complete board assemblies appear in Section 7, Replaceable Electrical Parts.

#### How to Remove the Digital Board (A2)

1. Unplug P3 (the connector for the POSSIBLE UNDERSAMPLING indicator) and P7 (the connector for the CLK IN jack) from the front of the board.

2. Unplug P2, P6 and P8 from the rear of the Sweep Board.

3. Remove the six screws that hold the Digital Board.

4. Lift the Digital Board and disconnect P4 and P5 from the underside of the board.

5. Set the Digital Board aside. Be careful to protect the switch contacts on the back of the board.

#### How to Install the Digital Board (A2)

1. Hold the Digital Board close to the 5B25N and install the P4 and P5 connectors to their pins on the back of the board.

2. Connect P2 (six-pin connector) and P6 (10-pin connector) to their respective groups of pins on the Sweep Board.

3. Set the Digital Board on the locating pins on the bearing blocks of the cam switch.

4. Install the six screws that retain the Digital Board. The four screws with captive washers fasten the Digital Board to the cam switch.

5. Connect the wires from the POSSIBLE UNDERSAMPLING light to P3 on the Digital Board.

6. Connect the wires from the CLK IN connector to P7 on the Digital Board.

7. Connect P8 (three-pin connector) to its pins on the Digital Board.

#### How to Remove the Sweep Board (A1)

Remove the Digital Board as described in "How to Remove the Digital Board."

2. Set the PRETRIGGER control to its detent - the clockwise position.

3. Use a 1/16-inch hex-key wrench to loosen the setscrew that retains the PRETRIGGER knob. Remove the knob.

4. Use a 1/16-inch hex-key wrench to remove the knob from the POSITION control.

5. Use a 5/16-inch nutdriver or wrench to remove the nut that fastens the POSITION control to the front panel.

6. Remove the POSITION control from the front panel.

7. Use a 5/16-inch nutdriver or wrench to remove the nut that fastens the PRETRIGGER potentiometer to the front panel.

8. Remove the TRIG'D socket-and-bulb assembly from its holding fixture on the front panel.

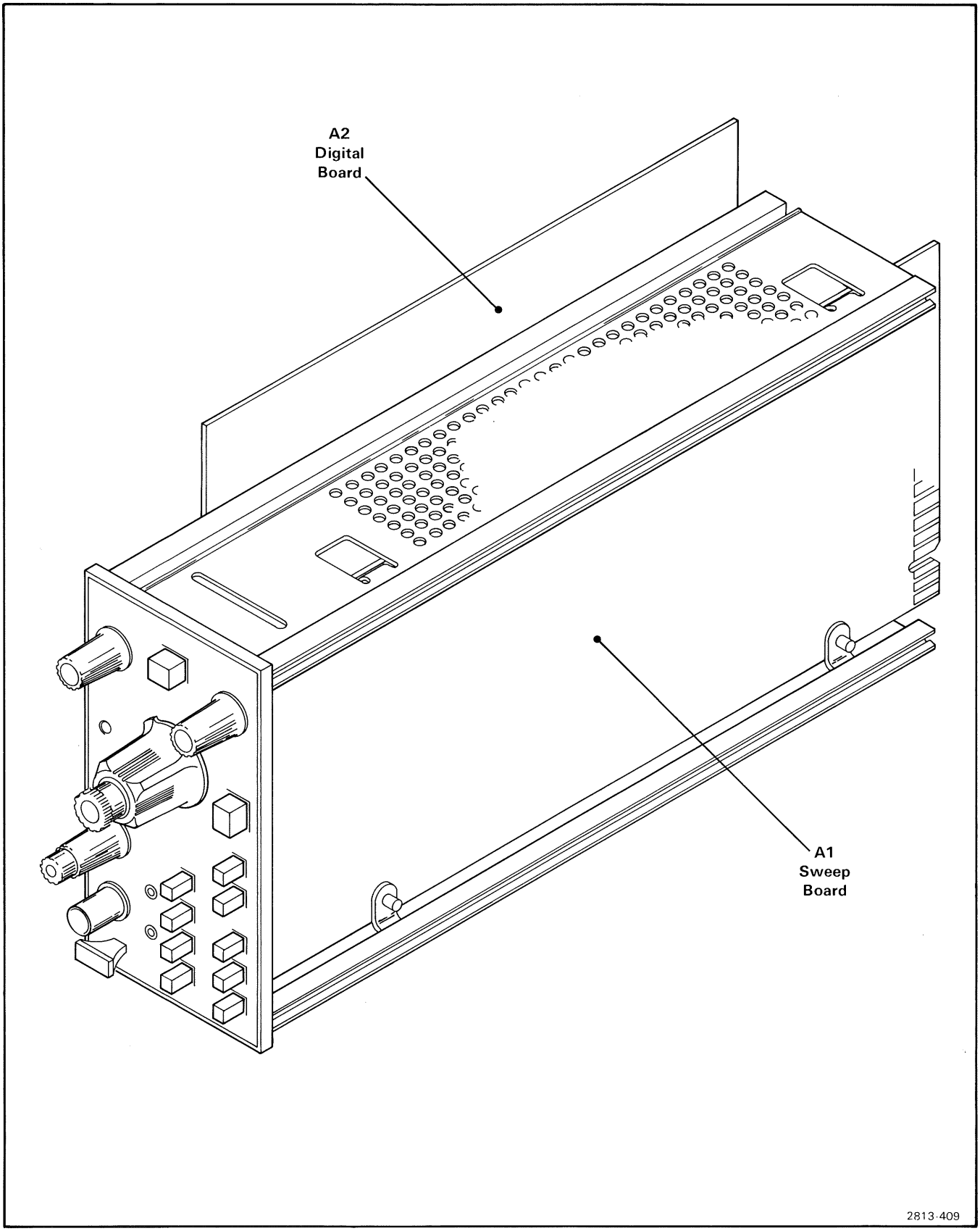



Figure 4-5. Circuit board locations.

9. Unplug the green (front) and blue (rear) connectors from the SLOPE and LEVEL/SENSITIVITY control. (Pin 1 of these connectors connects to the outboard pins.)

10. Use a low-power soldering iron (about 15 W) to unsolder the following:

a. the white-orange coaxial cable from the SWP OUT connector on the front panel,

b. the green wire from the EXT INPUT connector on the front panel, and

c. the brown wire from the ground lug on the EXT INPUT connector.

11. Set the CAL knob to its detent position.

12. Use a 0.050-inch hex-key wrench to remove the CAL knob.

13. Set the TIME/DIV control to AMPL position.

14. Use a 1/16-inch hex-key wrench to remove the TIME/DIV knob.

15. Disconnect the actuating bar from the DISPLAY switch shaft as follows:

a. Support the actuating bar by holding it with long-nose pliers or other suitable tool.

b. Insert the point of a scribe, or other sharp-pointed tool, between the switch-actuating bar and the end of the switch shaft as shown in Figure 4-6. Push the scribe in to separate the bar from the shaft.

16. Withdraw the DISPLAY switch-actuating bar from the 5B25N.

17. Disconnect the actuating bar from the X10 SWP MAG switch. Use the method described in step 15 to disconnect the bar from the shaft.

18. Withdraw the X10 SWP MAG actuating bar from the 5B25N.

19. Remove Q202 and Q209, the two transistors between the rear of the PRETRIGGER control and the board-mounting bracket. This provides clearance to remove the Sweep Board. Figure 4-7 shows Q202 and Q209.

20. Remove the four screws that hold the Sweep Board to the frame.

21. Carefully remove the Sweep Board from the chassis.

22. Install Q202 and Q209. The "-216" marked on the board, by the transistor socket farthest from the front of the Sweep Board, indicates that the transistor installed there should have Tektronix Part No. 151-0216-00.

## How to Install the Sweep Board (A1)

1. Remove Q202 and Q209, the two transistors nearest the PRETRIGGER control. Figure 4-7 shows Q202 and Q209.

2. Hold the plug-in frame with its right side (the side where the PRETRIGGER control installs) facing you.

3. Orient the Sweep Board with its component side facing you.

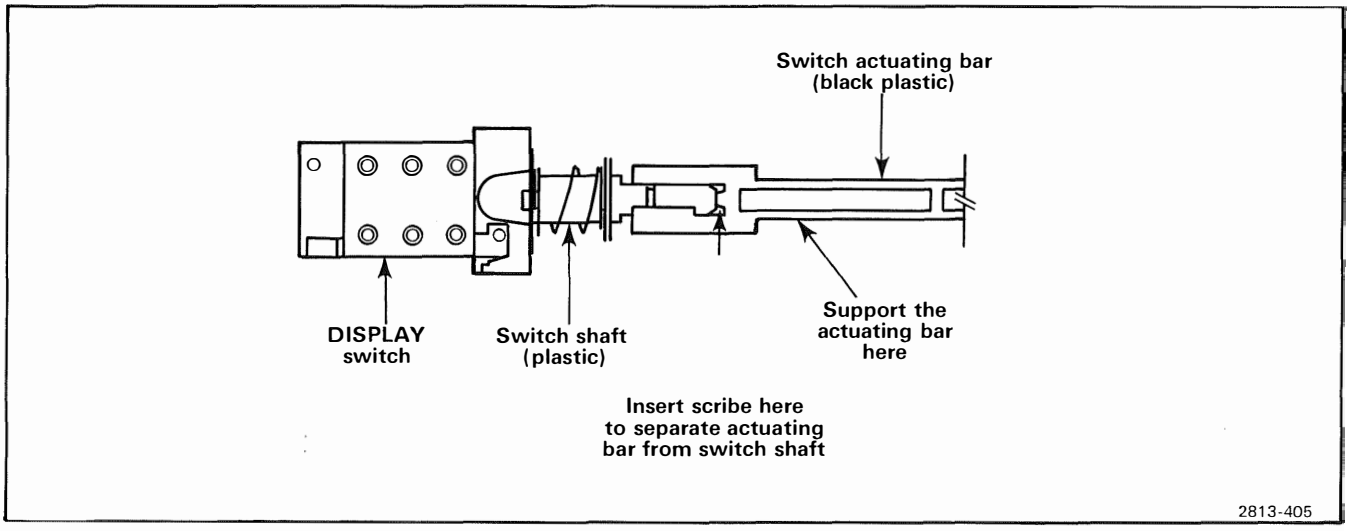



**Figure 4-6. How to disconnect actuating bar from DISPLAY switch.**

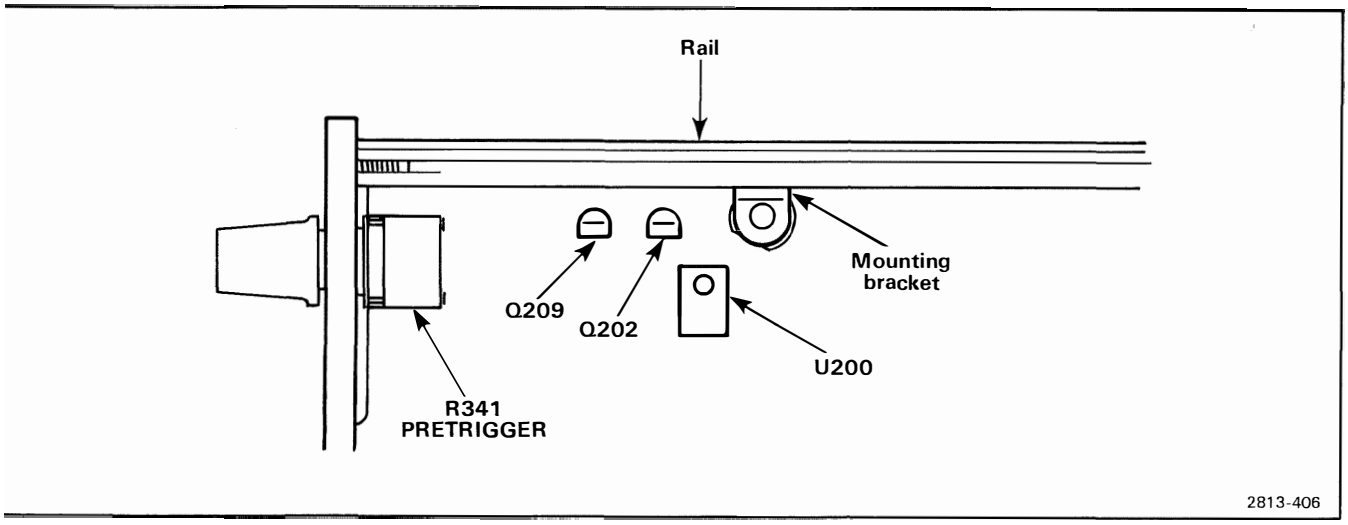



**Figure 4-7. Location of Q202 and Q209.**

4. Insert the Sweep Board through the rear of the plug-in frame.

5. Align the shaft of the TIME/DIV switch with its hole in the front panel.

6. Align the shaft of the PRETRIGGER control with its hole in the front panel.

7. Move the Sweep Board toward the front of the 5B25N to engage the TIME/DIV and PRETRIGGER shafts in their respective holes.

8. Align the nine TRIGGER SOURCE, MODE, and COUPLING pushbuttons with their holes in the front panel.

9. Push the Sweep Board forward to its correct location. You may need to guide the pushbuttons into their holes.

10. Check the bushings in the pushbutton holes and the TIME/DIV switch shaft hole. If any were dislodged, press them into place.

11. Start the four circuit-board retaining screws, but do not tighten them.

12. Install the POSITION control.

13. Install the flat washer and nut on the PRETRIGGER control.

14. Tighten the circuit-board retaining screws.

15. Install Q202 and Q209. The "-216" marked on the board, by the transistor socket furthest from the front of the Sweep Board (Q202), indicates that the transistor installed there should have Tektronix Part No. 151-0216-00.

16. Install the TIME/DIV knob.

17. Orient the TIME/DIV knob so that it is in the AMPL position. Locate the knob about 1/32-inch from the front-panel and tighten one of its setscrews.

18. Rotate the TIME/DIV knob to the extremes of its travel to verify that it is oriented correctly. If it is, tighten the other setscrew. If not, correct the orientation, verify that it is now right, and tighten the other setscrew.

19. Press the Variable TIME/DIV shaft in, and install the CAL knob.

20. Orient the CAL knob so that:

a. it goes into the TIME/DIV knob far enough that the yellow band is not visible, and

b. the word "CAL" is parallel to the top of the 5B25N.

21. Tighten the setscrew in the CAL knob.

22. Use a low-power soldering iron (about 15 W) to solder the following:

a. the white-orange coaxial cable to the SWP OUT connector,

b. the green wire to the center of the EXT INPUT connector, and

c. the brown wire to the ground lug on the EXT INPUT connector.

23. Install the green LED in the TRIG'D housing.

24. Install the green (front) and blue (rear) connectors on the SLOPE and LEVEL/SENSITIVITY control (Pin 1 of these connectors connects to the outboard pins of the control).

25. Install the switch-actuating bars on the DISPLAY and X10 SWP MAG controls. (The DISPLAY knob is the one marked "CHOP.")

26. Install the PRETRIGGER and POSITION knobs and verify that they are oriented correctly.

27. Replace the Digital Board as described in "How to Install the Digiital Board."

This completes the installation of the Sweep board.

## FRONT-PANEL LIGHTS

The 5B25N uses LED's (light-emitting diodes) and an incandescent lamp for front-panel lights.

The POSSIBLE UNDERSAMPLING, TRIG'D and SINGLE SWEEP READY indicators are LED's. To replace LED's, remove the cap from the sleeve, as shown in Figure 4-8. Note lead wire color coding and LED lead configuration. Unsolder wire leads and remove LED from the cap. Solder the replacement LED and lead wires to the socket cap as noted previously. Install the cap in the sleeve.

An incandescent lamp (DS325) illuminates the X10 SWP MAG pushbutton. This lamp is soldered to the Sweep Board.

To replace DS325, remove the actuating bar for the X10 SWP MAG switch. (See step 15 in "How to Remove the Sweep Board," in this section.) This will provide access to the two pads where DS325 is soldered. Use a pair of slender tweezers to grasp the leads from the other side of the board, and heat the solder joint from the exposed side of the board.

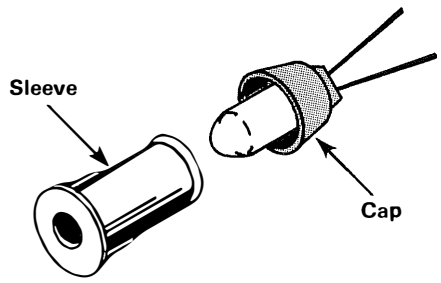



**Figure 4-8. Details of front-panel light assembly.**

Use a wick or other tool to remove solder from the holes. Then install a new lamp and replace the actuating bar for the X10 SWP MAG switch.

## SEMICONDUCTORS

Semiconductors should be replaced only when defective. If removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement of semiconductors may affect the accuracy of the instrument. When semiconductors are replaced, check the operation of circuits which may be affected.

**WARNING**

*To avoid electrical-shock hazard, always unplug the 5B25N from the mainframe before replacing components.*

Replacement semiconductors should be of the original type or a direct replacement. Lead configurations of the semiconductors used in this instrument are shown in Figure 4-3. Some plastic-cased transistors have lead configurations different from those shown. If a replacement transistor is made by a different manufacturer than the original, check the manufacturer's basing diagram.

## CIRCUIT-BOARD PIN REPLACEMENT

A circuit-board pin replacement kit, including necessary tools, instructions, and replacement pins with attached spare ferrules, is available from Tektronix, Inc. Order Tektronix Part 040-0542-00.

To replace a damaged pin, first disconnect any connectors. Then unsolder (see Soldering Techniques) the damaged pin and pull it from the board with a pair of pliers, leaving the ferrule (see Fig. 4-9) in the hole if possible. If the ferrule remains in the circuit board, remove the spare ferrule from the replacement pin and press the new pin into the hole in the circuit board. If the ferrule is removed with the damaged pin, clean out the hole using a solder-removing wick and a scribe. Then press the replacement pin, with attached spare ferrule, into the hole. Position the replacement pin in the same manner as the original pin was positioned. Solder the pin to the circuit board on each side of the circuit board. If the original pin was bent at an angle to mate with a connector, carefully bend the new pin to the same angle. Replace the pin connector.

## END-LEAD PIN CONNECTORS

The pin connectors used to connect the wires to the interconnecting pins are clamped to the ends of the associated leads. To remove or replace damaged end-lead pin connectors, remove the old pin connector from the end of the lead and clamp the replacement connector to the lead.

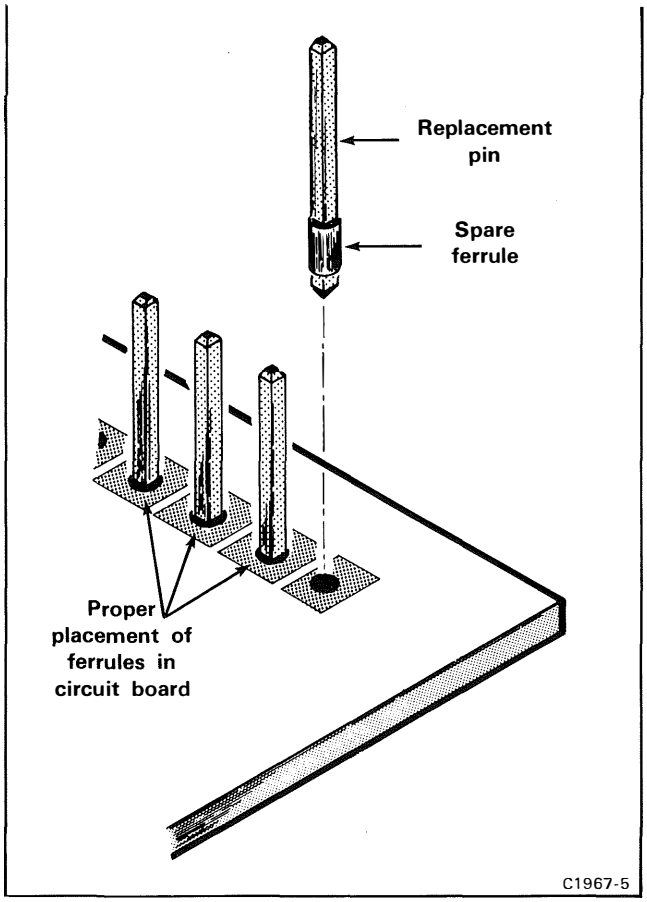



**Figure 4-9. Exploded view of circuit-board pin and ferrule.**

All of the pin connectors are grouped and mounted in plastic holders; these connectors are removed and installed as multi-pin connectors (see Troubleshooting Aids). If the individual end-lead pin connectors are removed from their plastic holder, note the order of the individual wires for correct replacement in the holder (see Fig. 4-4).

## SWITCHES

The 5B25N has two types of switches—pushbutton and cam actuated.

Contact alignment, spacing and tension are critical to the proper operation of the cam switches. Therefore, defective cam switches should be repaired only by personnel experienced with this type switch configuration. The following special maintenance information is provided for switch replacement.

Additional information will be provided on request by your local Tektronix Field Office or representative.

### Cam Switches

The cam-actuated switch consists of a rotating drum with lobes which actuate spring-leaf contacts. The contacts are soldered to the adjacent circuit board.

**CAUTION**

*Cam switch repair should be undertaken only by experienced maintenance personnel. Switch alignment, contact spacing, and spring tension must be carefully maintained for proper operation. A cam switch repair kit is available (Tektronix part 040-0541-00) which contains special alignment tools for use in repairing or replacing the switch contacts. For information or assistance on maintenance of cam switches, contact your local Tektronix Field Office or representative.*

**Cam Switch Replacement.** Remove and replace the cam switch drum and detent assembly as follows:

1. Follow the procedure "How to Remove the Digital Board (A2)"; then proceed with the following instructions.

2. Loosen the setscrew in the CAL shaft coupler, then remove the CAL knob and shaft together (see Fig. 4-10).

3. Remove the TIME/DIV knob.

4. Locate the four bearing-block retaining screws on either side of the plastic X10 SWP MAG switch extender shaft (see Fig. 4-11).

5. Remove the four screws.

6. Remove the drum assembly from the instrument. Be careful of the switch contacts beneath the drum.

**NOTE**

*Instructions for switch contact replacement are provided with the cam switch repair kit.*

7. Replace the cam-actuator switch drum and detent assembly by reversing the removal procedure, then follow the procedure for "How to Install the Digitizer board (A2)."

### Pushbutton Switches

The pushbutton switches are not repairable and should be replaced as a unit if defective. The individual connecting pins are easily accessible from the back of the board. Use a de-soldering tool or a solder wick to remove solder from the holes in the circuit board when unsoldering the switches.

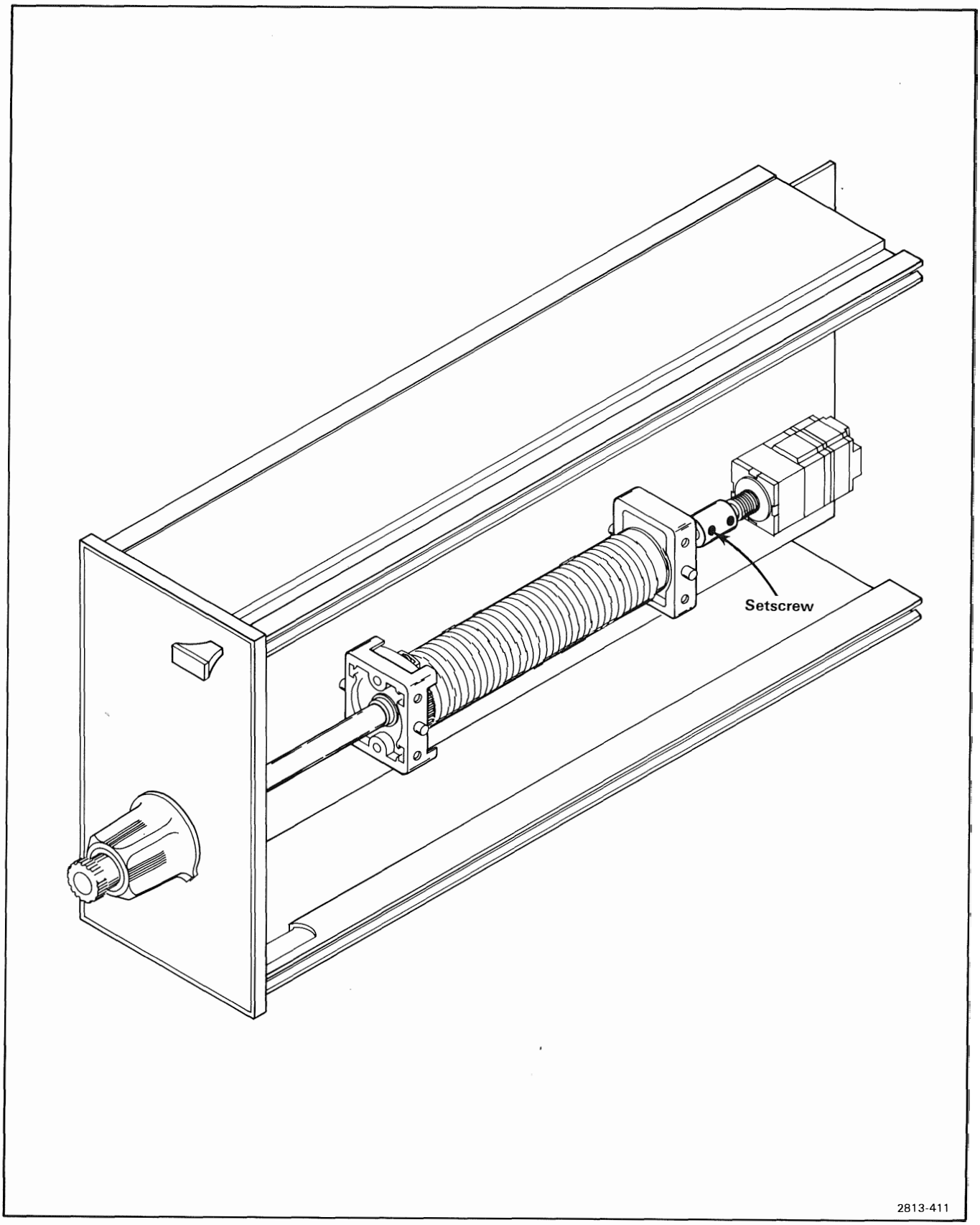



Figure 4-10. Location of setscrew in CAL shaft coupler.

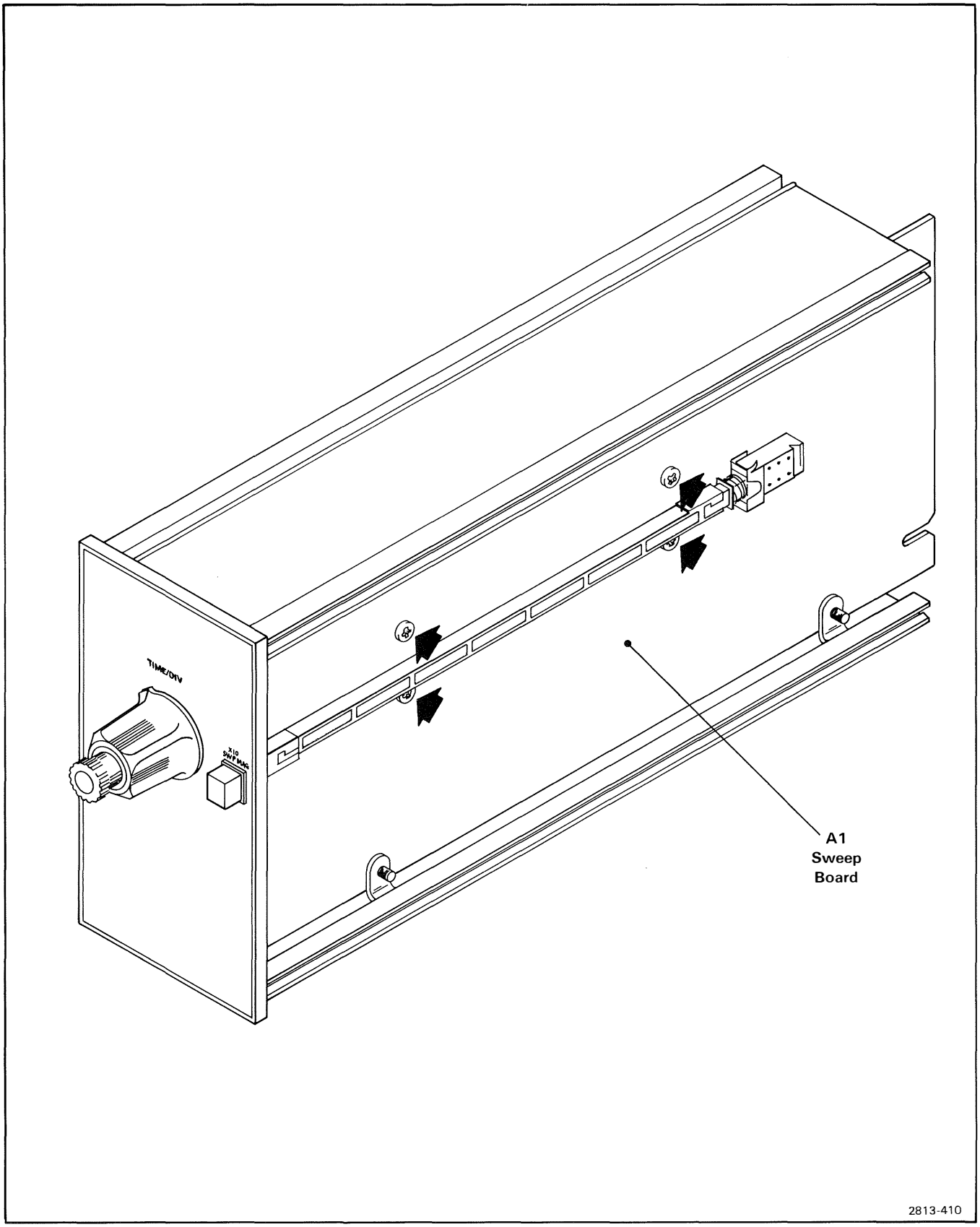



Figure 4-11. Location of four screws that retain the cam-switch bearing-blocks to the Sweep Board.

# CALIBRATION

This section contains procedures for calibrating the 5B25N. These procedures are designed to compare the performance of this instrument with measurement instruments of known accuracy to detect, correlate, or eliminate by adjustment, any variation from the electrical specifications. These procedures also verify that the controls function properly.

This section has two parts: Part I—Performance Check, for those who wish to verify that this instrument meets the applicable electrical specifications in section 1 without making internal adjustments. Part II—Adjustment and Performance Check is a complete calibration procedure that includes adjustments and performance checks in addition to verifying that the controls function properly. The procedures in Part I and Part II are written so that the entire instrument, or any major circuit or part of a circuit, can be checked or adjusted.

Table 5-1, Calibration Procedure Electives, lists the choices available and instructions for performing complete or partial calibration procedures. Also refer to Using These Procedures, for more detailed information.

## USING THESE PROCEDURES

**NOTE**

*In these procedures, capital letters within the body of the text identify front-panel controls, indicators, and connectors on the 5B25N (e.g., AUTO). Initial capitals identify all the associated test equipment and its controls, indicators, and connectors (e.g., Amplitude) used in the procedures. Initial capitals also identify internal adjustments of the 5B25N (e.g., Mag Gain).*

These procedures are divided into subsections by major functional circuits (e.g., A. Triggering, B. Sweep, etc.). The order in which the subsections and procedures appear is the recommended sequence for a complete performance check or calibration of the instrument.

The first step in each subsection (A1, B1, C1, etc.) contains reference information and control settings that must be performed before proceeding.

The Setup Conditions provide equipment connection information and control settings for both this instrument and any associated test equipment. Also, the Setup Conditions are written so that if desired, each subsection (A, B, C, etc.) or step (A2, A3, B2, B3, etc.) can be performed independently.

**TABLE 5-1**
**Calibration Procedure Electives**

| Electives | Procedures |
|---|---|
| Function Check | 1. A functional check only is provided in the Checkout Procedure in section 2. |
| | 2. A functional check is also accomplished by performing Part II—Adjustment and Performance Check. |
| Performance Check Only | Perform Part I—Performance Check. |
| Complete Calibration | Perform Part II—Adjustment and Performance Check. |
| Partial Procedures | Proceed to the desired step(s) (e.g., A2, A3, B2, B3, etc.; as listed in the Index to Part I—Performance Check or Index to Part II—Adjustment and Performance Check).<br>**NOTE**<br>*When adjustments are made we recommend that the entire major functional circuit procedure be performed.* |

The terms CHECK, EXAMINE, ADJUST, or INTERACTION when used as the first word of an instruction are defined as follows:

1. **CHECK**—indicates the instruction accomplishes an electrical specification check. Each electrical specification checked is listed in Table 5-2, Performance Check Summary (see the following Performance Check Summary discussion for more information).

2. **EXAMINE**—usually precedes an ADJUST instruction and indicates that the instruction determines whether adjustment is necessary. If no ADJUST instruction appears in the same step, the EXAMINE instruction concerns measurement limits that have no related adjustment. Measurement limits following the word EXAMINE are not to be interpreted as electrical specifications. They are provided as indicators of a properly functioning instrument and to aid in the adjustment process.

3. **ADJUST**—describes which adjustment to make and the desired result. We recommend that adjustments not be made if a previous CHECK or EXAMINE instruction indicates that no adjustment is necessary.

4. **INTERACTION**—indicates that the adjustment described in the preceding instruction interacts with other circuits. The nature of the interaction is described and reference is made to the step(s) affected.

## PERFORMANCE CHECK SUMMARY

Table 5-2, Performance Check Summary, lists the electrical specifications that are checked in Part I and Part II of this section. Table 5-2 is intended to provide a convenient means for locating the procedures in Part I and Part II that check or adjust the instrument to meet the applicable electrical specifications. For example: if the Sweep Generator had been repaired, use Table 5-2 to locate the electrical specifications affected by the repair. Then note the title of the procedure in Part I or Part II in which those specifications are checked and/or adjusted. Use the index provided at the front of Part I and Part II to determine the page number of the desired procedures.

## ADJUSTMENT INTERVAL

To maintain instrument accuracy, check performance every 1000 hours of operation, or every 6 months if used infrequently. Before complete adjustment, thoroughly clean and inspect this instrument as outlined in the Maintenance section.

**TABLE 5-2**
**Performance Check Summary**

| Characteristic | Performance Requirement | Part I Performance Check Procedure Title | Part II Adjustment and Performance Check Procedure Title |
|---|---|---|---|
| **HORIZONTAL SYSTEM** | | | |
| Sweep Rates | | | |
| Calibrated Range | 5 s/div to 0.2 μs/div in 23 steps. X10 Magnifier extends fastest calibrated sweep rate to 20 ns/div. | B5. Check Sweep Timing. | B2. Examine/Adjust Low-Frequency Timing. |
| | | C3. Check Timing & Linearity of Magnified Sweep. | B6. Examine/Adjust High-Frequency Timing. |
| | | | B7. Check Sweep Timing. |
| | | | C3. Check Timing & Linearity of Magnified Sweep. |
| Variable Range | Continuously variable uncalibrated sweep rate to at least 2.5 times the calibrated sweep rate setting. | B4. Check Variable TIME/DIV Timing. | B5. Check Variable TIME/DIV Timing. |

TABLE 5-2 (CONT)
Performance Check Summary

| Characteristic | Performance Requirement | Part I Performance Check Procedure Title | Part II Adjustment and Performance Check Procedure Title |
|---|---|---|---|
| **HORIZONTAL SYSTEM (CONT)** | | | |
| Sweep Accuracy[1] with 5223 and 5400-Series Mainframes | Measured over center 8 displayed divisions. LF Timing is adjusted at 0.5 ms/div within the +20° to +30° C range. | | |
| +15 to +35° C | UNMAG / MAG X10 | B5. Check Sweep Timing. | B7. Check Sweep Timing. |
| 2 s/div and 5 s/div | 4% / 5% | | |
| 1 s/div to 0.2 μs/div | 3% / 4% | | |
| 0 to +50° C | Derate +15° to +35° C accuracy by additional 1%. | Customer verification normally not required. | |
| Sweep Length | At least 10.5 div. | B2. Check Sweep Length. | B3. Check Sweep Length. |
| Sweep Out Voltage | | | |
| Into 1 kΩ | 0.1 V/div ±6%. | B7. Check Sweep Out Voltage. | B9. Check Sweep Out Voltage. |
| Position Range | | | |
| POSITION Control Fully CW | Start of sweep must be to right of graticule center at 1 ms/div. | B3. Check Position Range | B4. Check Position Range. |
| POSITION Control Fully CCW | At least 10 divisions of sweep must be to left of graticule center at 1 ms/div. | | |

[1] Some mainframes limit fastest calibrated sweep rate.

TABLE 5-2 (CONT)
Performance Check Summary

| Performance Characteristic | Performance Check Requirement | Part I Performance Check Procedure Title | Part II Adjustment and Performance Check Procedure Title |
|---|---|---|---|
| **TRIGGERING SYSTEM** | | | |
| Triggering | | | |
| + or − Slope | | | |
| Sensitivity | | | |
| Internal Trigger | | | |
| With any 5A30- or 5A40-Series Amplifier | 0.4 div, dc[1] to 1 MHz.<br>0.6 div, 1 MHz to 15 MHz. | A4. Check 1 MHz Triggering.<br><br>A5. Check 15 MHz Triggering. | A4. Check 1 MHz Triggering.<br><br>A5. Check 15 MHz Triggering. |
| With any 5A10- or 5A20-Series Amplifier | 0.4 div, dc[1] to amplifier bandwidth. | Use step A5 with the bandwidth specification of the 5A10- or 5A20-Series amplifier in use. | Use step A5 with the bandwidth specification of the 5A10- or 5A20-Series amplifier in use. |
| External Trigger | | | |
| With any 5A30- or 5A40-Series Amplifier | 50 mV, dc[1] to 1 MHz.<br>200 mV, 1 MHz to 15 MHz. | A6. Check 15 MHz External Triggering.<br><br>A7. Check 1 MHz External Triggering. | A6. Check 15 MHz External Triggering.<br><br>A7. Check 1 MHz External Triggering. |
| With any 5A10- or 5A20-Series Amplifier | 50 mV, dc[1] to amplifier bandwidth. | Use step A6 with the bandwidth specification of the 5A10- or 5A20-Series amplifier in use. | Use step A6 with the bandwidth specification of the 5A10- or 5A20-Series amplifier in use. |
| Single Sweep | Same as for Repetitive and Pulsed Triggering | Customer verification normally not required. Satisfactory operation is substantiated by other tests in the procedures. | |
| External Trigger Input | | | |
| Maximum Safe Input | | Specification applicable under fault conditions; therefore this is not a procedural check. | |
| 1-Megohm Input | 350 V (dc plus peak ac). | | |
| Input R and C | | Customer verification normally not required. Input resistance and capacitance can be determined with appropriate testing bridge if necessary. | |
| 1-Megohm Input | 1 MΩ within 2%, 24 pF ±4 pF. | | |

[1] 30 Hz when ac coupled.



@

TABLE 5-2 (CONT)
Performance Check Summary

| Characteristic | Performance Requirement | Part I Performance Check Procedure Title | Part II Adjustment and Performance Check Procedure Title |
|---|---|---|---|
| **DIGITIZER-RELATED FUNCTIONS** | | | |
| Digitizer-Related Functions (in 5223 Mainframe Only) | | | |
| Overall digitized signal-speed accuracy-center 8 divisions. Excluded portions: First 200 ns/0.2 div of each waveform | Digitized Waveform; Digitized Waveform Relative to Real-Time Waveform (Cal / Uncal) | E2. Check VCO Fast.<br>E3. Check VCO Slow.<br>E5. Check Sample Full-Scale | E2. Examine/Adjust VCO Fast.<br>E3. Examine/Adjust VCO Slow.<br>E5. Examine/Adjust Sample Full-Scale |
| 2 and 5 s/div | 3% | 4% / 6% | |
| 1 s - 0.1 ms/div | 3% | 3% / 5% | |
| 50 μs - 0.2 μs/div | 3% | 3% / 3% | |
| Pretrigger Adjustment Range | Continuously variable from 0 to 100% of the display stored in memory. | E8. Check PRETRIGGER Function. | E8. Check PRETRIGGER Function. |
| Possible Undersampling Indicator | Operates only at sweep speeds of 0.1 ms/division and slower. Lights when there are 8 or fewer sample pulses per trigger event. | E7. Check POSSIBLE UNDERSAMPLING Indicator. | E7. Check POSSIBLE UNDERSAMPLING Indicator. |
| CLK IN Signal | | E9. Check External Sample Clock In Function. | E9. Check External Sample Clock In Function. |
| Voltage Limits | High, +2.4 to +5.0 V<br>Low, −0.5 to +0.4 V | | |
| Frequency, Maximum | 1 MHz | | |

## TEKTRONIX FIELD SERVICE

Tektronix Field Service Centers and the Factory Service Center provide instrument repair and adjustment services. Contact your Tektronix Field Office or representative for further information.

## SPECIAL FIXTURES

Special fixtures are used only where they facilitate instrument adjustment. These fixtures are available from Tektronix, Inc. Order by part number from Tektronix Field Offices or representatives.

## TEST EQUIPMENT ALTERNATIVES

All of the listed test equipment is required to completely calibrate this instrument. However, complete checking or adjusting may not always be necessary or desirable. You may be satisfied with checking only selected characteristics, thereby reducing the amount of test equipment actually required.

The calibration procedures in Part I and Part II are based on the first item of equipment given as an example. When other equipment is substituted, control settings or setups may need to be altered. If the exact item of equipment given as an example in Table 5-3 is not available, first check the Minimum Specifications column carefully to see if any other equipment might suffice. Then check the Purpose column to see why this item is used. If used for a performance check or adjustment that is of little or no importance for your measurement requirements, the item and corresponding step(s) can be deleted.

# TEST EQUIPMENT REQUIRED

The test equipment listed in Table 5-3 is required for a complete Adjustment and Performance Check of the instrument. If only a Performance Check is to be performed, the items listed for Adjustment are not required and are indicated by footnote 1. The remaining test equipment is common to both procedures.

The specifications for test equipment given in Table 5-3 are the minimum required to meet the performance requirements. Detailed operating instructions for test equipment are omitted in these procedures. Refer to the test equipment instruction manual if more information is needed.

**TABLE 5-3**
**Test Equipment**

| Description | Minimum Specifications | Purpose | Examples of Applicable Test Equipment |
|---|---|---|---|
| 1. 5223 Digitizing Oscilloscope | | Works with 5B25N. | No substitute. |
| 2. Dual-Trace Amplifier | Bandwidth, dc -35 MHz; sensitivity, 10 mV/div. | Permits input to 5223 vertical system. | a. TEKTRONIX 5A38 Dual-Trace Amplifier.<br>b. TEKTRONIX 5A48 Dual-Trace Amplifier. |
| 3. Calibration Generator (Square-wave Generator) | Amplitude Calibrator Mode; Frequency, approx. 1 kHz; amplitude 0.5 V to 10 V into 2 MΩ; within 0.25%. Pulse Mode: High-Amplitude Output; Frequency 1 kHz to 100 kHz; amplitude, 0.5 V to 10 V into 50 Ω; risetime, 10 ns or less into 50 Ω. | Check & Adjust Gain and compensation of external horizontal input.<br>Check & adjust VCO Slow and Fast. Check External Clock In function. | a. TEKTRONIX PG 506 Calibration Generator (operates in TM 500-series Power Module). |

TABLE 5-3 (CONT)
Test Equipment

| Description | Minimum Specifications | Purpose | Examples of Applicable Test Equipment |
|---|---|---|---|
| 4. Sine-wave Generator | Frequency range, 50 kHz to at least 20 MHz; reference frequency, 50 kHz; amplitude accuracy, constant within 5% of reference as output frequency changes. | Check & adjust trigger sensitivity, check trigger bandwidth, slope and coupling. Check & adjust sample zero, sample full-scale, and high rate compensation. | a. TEKTRONIX SG 503 Leveled Sine-Wave Generator (operates in TM 500-series Power Module). |
| 5. Time Mark Generator | Markers, 20 ns through 5.0 s intervals. Amplitude, at least 1.0 V into 50 Ω; Accuracy, within 1 part in $10^5$. | Check timing. Check External Clock In Function. | a. TEKTRONIX TG 501 Time-Mark Generator (operates in TM 500-series Power Module). |
| 6. Power Module Mainframe (TM 500-series) | Capable of powering and housing 3 to 6 TM 500-series test instruments. | Provide housing and power for TM 500-series test signal generators. | a. TEKTRONIX TM 503, TM 504 or TM 506 Power Module. |
| 7. Dual-input Coupler | Impedance, 50 Ω connectors, bnc, male 2, female, 1. | Check 1 MHz and 20 MHz external triggering. | a. Tektronix 067-0525-01 Calibration Fixture. |
| 8. Coaxial cables (2 required) | Impedance, 50 Ω; length, 42 inches, 1 each, 18 inches, 1 each; connectors, bnc male. | Provide signal interconnection. | a. Tektronix part 012-0057-01, 42-inch; 012-0076-00, 18 inch. |
| 9. Terminator | Impedance, 50 Ω; connectors, bnc; power, 2-W maximum | Terminate output of sine-wave and time-mark generators. | a. Tektronix part 011-0049-01. |
| 10. Resistor | Value 1 kΩ; tolerance, 1/4%; power 1/8W. | Check Sweep Out. | a. Tektronix part 321-0193-07. |
| 11. Connector, bnc 'T' | Connectors, bnc, male, 1; female, 2 | Check External Clock In Function. | a. Tektronix part 103-0030-00. |
| 12. Patch Cord | Mini-pin to mini-pin. | Check External Clock In Function. | a. Tektronix part 012-0310-00. |
| 13. Alignment Tool[1] | Blade, 5/32"; length, 5". | Adjust internal resistors and capacitors. | a. Tektronix part 003-0000-00. |
| 14. Alignment Tool[1] | Blade, 5/32"; length, 2-1/8". | Adjust internal resistors and capacitors on Digital Board. | a. Modified Tektronix part 003-0000-00. (pull shaft out of handle and use shaft as an alignment tool). |

[1] Used for Part II—Adjustment and Performance Check only; NOT used for Part I—Performance Check.

# PART I—PERFORMANCE CHECK

The following procedure (Part I—Performance Check) verifies electrical specifications without making internal adjustments. All tolerances given are as specified in the Specification tables (section 1) in this manual.

Part II—Adjustment and Performance Check provides the information necessary to: (1) verify that the instrument meets the electrical specifications, (2) verify that the controls function properly, and (3) perform all internal adjustments.

A separate Checkout Procedure is provided in section 2 to provide instrument familiarization and to verify that the controls function properly.

See Table 5-1, Calibration Procedure Electives, at the beginning of this section, for information on performing a Partial Part I—Performance Check procedure.

## INDEX TO PART I—PERFORMANCE CHECK



## PERFORMANCE CHECK POWER-UP SEQUENCE

**NOTE**

*The performance of this instrument can be checked at any ambient temperature from 0° to +50° C unless otherwise stated. Adjustments must be performed at an ambient temperature from +15° to +25° C for specified accuracies.*

1. Install the 5B25N in the right-hand plug-in compartment of a 5223 mainframe.

2. Install a 5A48, or its equivalent, in the left-hand vertical plug-in compartment of the mainframe.

3. Switch on the mainframe and appropriate test equipment and allow at least 20 minutes warmup time before proceeding.

# A. TRIGGERING

**Equipment Required:** (Numbers correspond to those listed in Table 5-3, Test Equipment.)

1. 5223 Digitizing Oscilloscope
2. Dual-Trace Amplifier
4. Sine-Wave Generator
5. Time-Mark Generator
6. Power Module Mainframe (for item 5)
7. Dual-Input Coupler
8. Coaxial Cable (18-inch)
9. Terminator (50 Ω)

Shaded lines identify Performance Requirement CHECK.

## A1. TRIGGERING PRELIMINARY SETUP

a. Perform the Performance Check Power-Up Sequence, which appears at the beginning of Part I, Performance Check.

b. Refer to Section 6, Instrument Options, and to the Change Information section at the back of this manual for any changes which may affect this procedure.

c. Set the 5B25N controls as follows:

TIME/DIV ..... 10 μs
TRIGGERING
  SLOPE ..... ±
  LEVEL/SENSITIVITY ..... Fully clockwise
  COUPLING ..... AC
  MODE ..... AUTO
  SOURCE ..... LEFT
DISPLAY ..... In (CHOP)
POSITION ..... Centered
X10 SWP MAG .....Off (button out)
PRETRIGGER ..... 0%

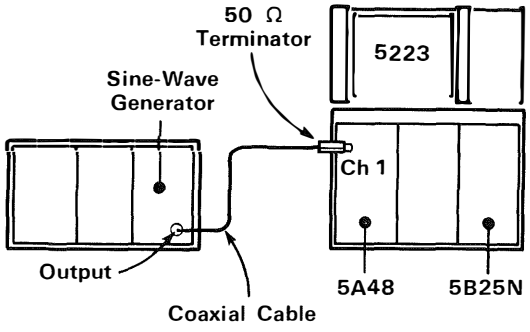
## A2. CHECK BISLOPE TRIGGERING

**NOTE**

*First perform step A1, then proceed.*

**A2. SETUP CONDITIONS**

5B25N Controls:
Make no changes to the control settings.




Test Equipment Controls:
Sine-Wave Generator
  Frequency ..... 50 kHz
  Amplitude ..... To produce 1 division of deflection on crt

5A48 Amplifier
  Ch 1 Volts/Div ..... 1
  Display ..... On
  Trigger ..... Ch 1
  Mode ..... Ch 1

2814-501

a. Center the display with the Ch 1 Position control on the 5A48 Amplifier.

b. Move the TRIGGERING LEVEL/SENSITIVITY control to its MAX position, which is fully counterclockwise.

c. Press the CH 1 Gnd button on the 5A48.

d. If necessary, adjust the 5A48's Ch 1 position control to center the trace.

e. Release the Ch 1 Gnd button.

f. The display should show two sine waves, one triggered on its + slope and one triggered on its − slope. If there is only one, adjust the Variable TIME/DIV control until two sine waves appear.

g. **CHECK**—the two waveforms to see if their starting points are equidistant from the horizontal center line. Figure 5-1 shows the desired display.

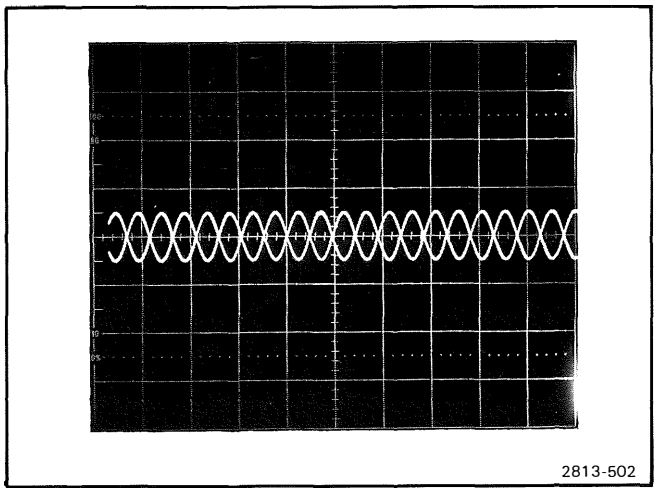



**Figure 5-1. Display of bislope triggering.**

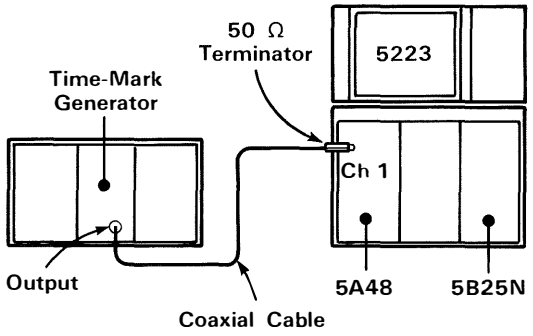
## A3. CHECK AUTO RECOVERY

**NOTE**

*If the preceding step was not performed, first perform step A1, then proceed.*

**A3. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 20 ms
  - Variable ..... In CAL detent
- TRIGGERING
  - SLOPE ..... +
  - LEVEL/SENSITIVITY ..... For triggered sweep




Test Equipment Controls:
- Time-Mark Generator
  - Markers ..... 50 ms intervals

5A48 Amplifier
- Ch 1 Volts/Div ..... 1
- Display ..... On
- Trigger ..... Ch 1

2813-503

a. **CHECK**—that sweep is triggered.

b. Set Time-Mark Generator to produce 0.5 s time marks.

c. **CHECK**—that sweep is not triggered.

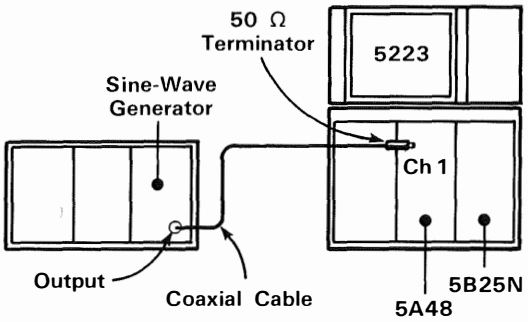
## A4. CHECK 1 MHz TRIGGERING

**NOTE**

*If the preceding step was not performed, first perform step A1, then proceed.*

**A4. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 2 μs
- TRIGGERING
  - COUPLING ..... AC
  - MODE ..... AUTO
  - SOURCE ..... RIGHT
  - SLOPE ..... +




Test Equipment Controls:

5A48 Amplifier (move to center compartment)
- Ch 1 Volts/Div ..... 1
- Display ..... On
- Trigger ..... Ch 1

Sine-Wave Generator
- Frequency ..... 1 MHz
- Amplitude ..... To produce 0.4 division of crt deflection.

2813-504

a. Verify that the input signal causes 0.4 division of deflection on the crt.

b. Press the 5B25N RIGHT TRIGGERING SOURCE button.

c. **CHECK**—that by adjusting the LEVEL/SENSITIVITY control, the sweep will trigger and produce a stable display.

d. **CHECK**—that the TRIG'D indicator is lighted.

e. Set TRIGGERING SLOPE to −.

f. **CHECK**—that by adjusting the LEVEL/SENSITIVITY control, the sweep will trigger and produce a stable display.

g. **CHECK**—that the TRIG'D indicator is lighted.

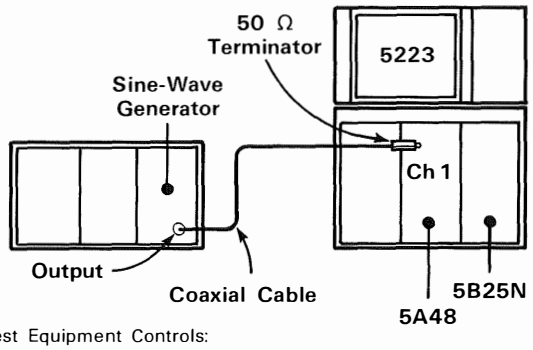
## A5. CHECK 15 MHz TRIGGERING

**NOTE**

*If the preceding step was not performed, first perform step A1, then proceed.*

**A5. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 0.2 μs
- TRIGGERING
  - COUPLING ..... AC
  - MODE ..... AUTO
  - SOURCE ..... RIGHT
  - SLOPE ..... +




Test Equipment Controls:

5A48 Amplifier
- Ch 1 Volts/Div ..... 1
- Display ..... On
- Trigger ..... Ch 1

Sine-Wave Generator
- Frequency ..... 15 MHz
- Amplitude ..... To produce 0.6 div deflection on crt.

2813-505

a. Verify that the 15 MHz input signal causes 0.6 division of deflection on the crt.

b. **CHECK**—that by adjusting the LEVEL/SENSITIVITY control the sweep will trigger and produce a stable display.

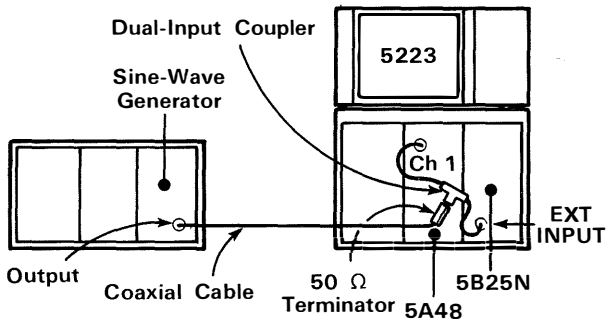
## A6. CHECK 15 MHz EXTERNAL TRIGGERING

**NOTE**

*If the preceding step was not performed, first perform step A1, then proceed.*

**A6. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 0.2 μs
- TRIGGERING
  - COUPLING ..... AC
  - MODE ..... AUTO
  - SOURCE ..... EXT
  - SLOPE ..... +




Test Equipment Controls:
- 5A48 Amplifier
  - Ch 1 Volts/Div ..... 0.1
  - Display ..... On
- Sine-Wave Generator
  - Frequency ..... 15 MHz
  - Amplitude ..... To produce 2 divisions of deflection on crt.

2813-506

a. Verify that the 15 MHz input signal causes 2.0 divisions of deflection on the crt.

b. **CHECK**—that adjusting the LEVEL/SENSITIVITY control causes the sweep to trigger and produce a stable display.

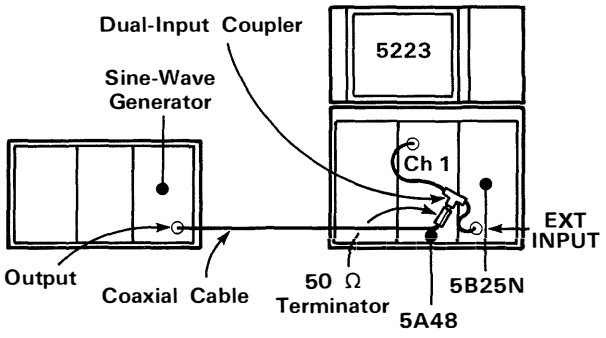
## A7. CHECK 1 MHz EXTERNAL TRIGGERING

**NOTE**

*If the preceding step was not performed, first perform step A1, then proceed.*

**A7. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 1 μs
- TRIGGERING
  - COUPLING ..... AC
  - MODE ..... AUTO
  - SOURCE ..... EXT
  - SLOPE ..... +




Test Equipment Controls:
- Sine-Wave Generator
  - Frequency ..... 1 MHz
  - Amplitude ..... To produce 0.5 division of deflection on crt.
- 5A48 Amplifier
  - Ch 1 Volts/Div ..... 0.1
  - Display ..... On

2513-507

a. Verify that the 1 MHz input signal causes 0.5 division of deflection on the crt.

b. **CHECK**—that adjusting the LEVEL/SENSITIVITY control causes the sweep to trigger and produce a stable display.

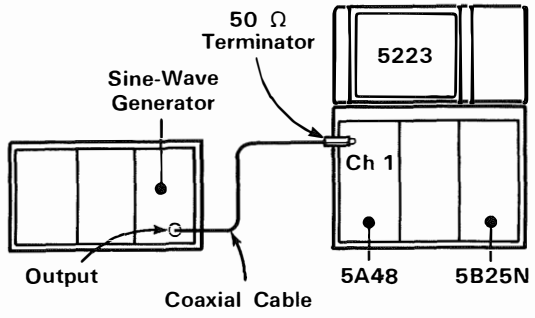
## A8. CHECK TRIGGERING SLOPE

**NOTE**

*If the preceding step was not performed, first perform step A1, then proceed.*

**A8. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 10 μs
- TRIGGERING
  - COUPLING ..... AC
  - MODE ..... AUTO
  - SOURCE ..... LEFT
  - SLOPE ..... +




Test Equipment Controls:
- Sine-Wave Generator
  - Frequency ..... 50 kHz
  - Amplitude ..... To produce 1 division of deflection on crt.

5A48 Amplifier (move to left compartment)
- Ch 1 Volts/Div ..... 0.1
- Display ..... On
- Trigger ..... Ch 1

2813-508

a. **CHECK**—that adjusting the LEVEL/SENSITIVITY control causes the sweep to trigger on the positive-going slope of the input signal.

b. Set the SLOPE control to −.

c. **CHECK**—that adjusting the LEVEL/SENSITIVITY control causes the sweep to trigger on the negative-going slope of the input signal.

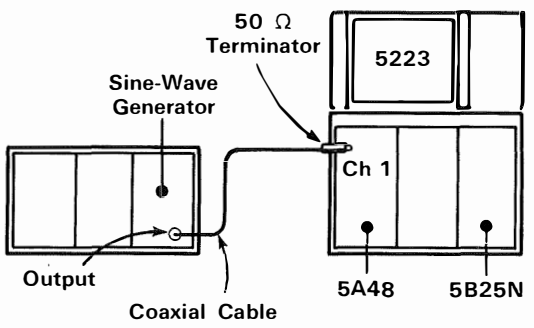
## A9. CHECK TRIGGERING COUPLING

**NOTE**

*If the preceding step was not performed, first perform step A1, then proceed.*

**A9. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 10 μs
- TRIGGERING
  - COUPLING ..... DC
  - MODE ..... AUTO
  - SOURCE ..... LEEFT
  - SLOPE ..... +




Test Equipment Controls:
- Sine-Wave Generator
  - Frequency ..... 50 kHz
  - Amplitude ..... To produce 1 division of deflection on crt.

5A48 Amplifier
- Ch 1 Volts/Div ..... 0.1
- Display ..... On
- Trigger ..... Ch 1

2813-509

a. Set the LEVEL/SENSITIVITY control so that trigger point is at center of waveform.

b. **CHECK**—that pressing the AC COUPLING button causes the trigger point (start of display) to move or causes the sweep to free-run.

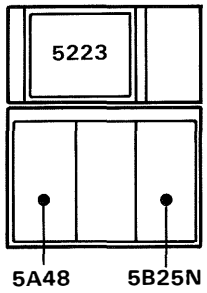
## A10. CHECK LINE TRIGGERING

### NOTE

*If the preceding step was not performed, first perform step A1, then proceed.*

**A10. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 1 ms
- TRIGGERING
  - COUPLING ..... AC
  - MODE ..... NORM
  - SOURCE ..... LINE
  - SLOPE ..... +
  - LEVEL/SENSITIVITY ..... Centered




Test Equipment Controls:
- 5A48 Amplifier
  - Position ..... To put trace on screen.
  - Display ..... On

2813-510

a. **CHECK**—that trace is present on screen, and that moving the LEVEL/SENSITIVITY control to the clockwise and counterclockwise extreme of its travel causes the trace to disappear.



@

# B. SWEEP

**Equipment Required:** (Numbers correspond to those listed in Table 5-3, Test Equipment.)

1. 5223 Digitizing Oscilloscope
2. Dual Trace Amplifier
5. Time-Mark Generator
6. Power Module Mainframe (for item 5)
8. Coaxial Cable (18-inch)
9. Terminator (50 Ω)
12. Patch Cord

Shaded lines identify Performance Requirement CHECK.

## B1. SWEEP PRELIMINARY SETUP

a. Perform the Performance Check Power-Up Sequence, which appears at the beginning of Part I, Performance Check.

b. Refer to Section 6, Instrument Options, and to the Change Information section at the back of this manual for any changes which may affect this procedure.

c. Set the 5B25N controls as follows:

TIME/DIV ..... 1 ms
TRIGGERING
  SLOPE ..... +
  LEVEL/SENSITIVITY ..... Centered
  COUPLING ..... AC
  MODE ..... AUTO
  SOURCE ..... LEFT
DISPLAY ..... In (CHOP)
POSITION ..... Centered
X10 SWP MAG ..... Off (button out)
PRETRIGGER ..... 0%

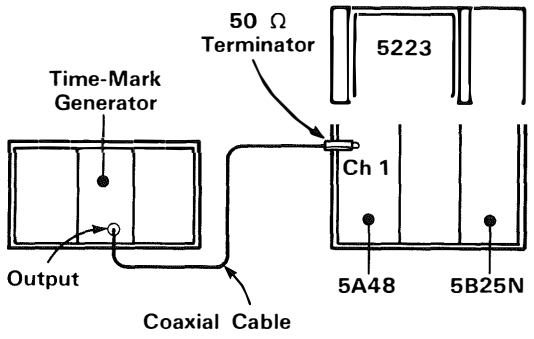
## B2. CHECK SWEEP LENGTH

**NOTE**

*First perform step B1, then proceed.*

**B2. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 1 ms




Test Equipment Controls:
5A48 Amplifier
Ch 1 Volts/Div ..... 1 V
Display ..... On
Trigger ..... Ch 1

Time-Mark Generator
Markers ..... 0.5 ms intervals

2813-549

a. Use the POSITION control to set the first marker to the left-most vertical graticule line.

b. **CHECK**—that the sweep is 10.5 divisions long by using the POSITION control to slowly move the display to the left. At least one 0.5 ms marker past the one at the end of the graticule should come on the right-hand side of the screen for the sweep to be 10.5 divisions long.

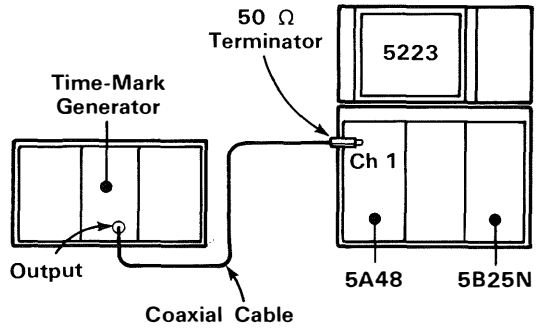
## B3. CHECK POSITION RANGE

**NOTE**

*If the preceding step was not performed, first perform step B1, then proceed.*

**B3. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 1 ms




Test Equipment Controls:
5A48 Amplifier
Ch 1 Volts/Div ..... 1 V
Display ..... On
Trigger ..... Ch 1

Time-Mark Generator
Markers ..... 0.5 ms intervals

2813-542

a. Use the POSITION control to set the first marker to the left-most vertical graticule line.

b. Move the display to the left so that you can see the 22nd marker, which is the first one past the 10-division vertical graticule line (it marks the 10.5 division point of the sweep).

c. **CHECK**—that the 10.5-division marker will move to the left of the center vertical graticule line when the POSITION control is set to its counterclockwise extreme.

d. **CHECK**—that the start of the sweep will move to the right of the center vertical graticule line by moving the POSITION control to its clockwise extreme.

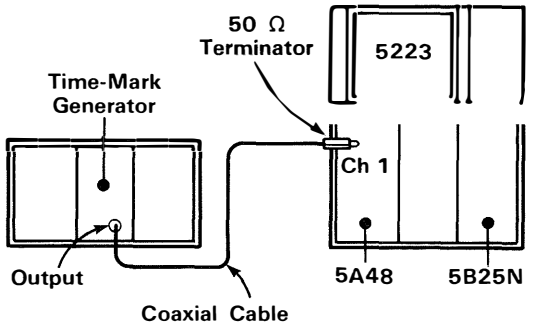
## B4. CHECK VARIABLE TIME/DIV TIMING

**NOTE**

*If the preceding step was not performed, first perform step B1, then proceed.*

**B4. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 0.1 ms




Test Equipment Controls:
5A48 Amplifier
Ch 1 Volts/Div ..... 1 V
Display ..... On
Trigger ..... Ch 1

Time-Mark Generator
Markers ..... 0.5 ms intervals

2813-543

a. Use the POSITION control to set the first marker to the left-most vertical graticule line.

b. Turn the Variable TIME/DIV control fully counterclockwise.

c. **CHECK**—that there is 2 divisions, or less, between adjacent markers.

d. Set Variable TIME/DIV to the CALibrated position.



@

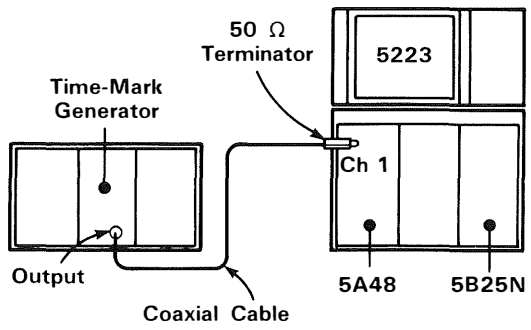
## B5. CHECK SWEEP TIMING

**NOTE**

*If the preceding step was not performed, first perform step B1, then proceed.*

**B5. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 0.2 μs




Test Equipment Controls:
5A48 Amplifier
Ch 1 Volts/Div ..... 1
Display ..... On
Trigger ..... Ch 1

Time-Mark Generator
Markers ..... 0.2 μs intervals

2813-544

**NOTE**

*The tolerances given in Table 5-4 are for an ambient temperature range of +15° to +35° C. If the temperature is outside this range, refer to section 1 for applicable tolerances.*

a. Set the POSITION control to midrange and the TRIGGERING MODE to NORM.

b. **CHECK**—using the TIME/DIV and time-mark generator settings from Table 5-4, check sweep accuracy for one time mark/division over the center eight divisions within the tolerance given in Table 5-4. Set the POSITION and TRIGGERING LEVEL/SENSITIVITY controls as necessary for a stable display aligned with the vertical graticule lines.

**NOTE**

*If the time-mark generator used does not have 1-2-5 sequence markers, apply 1 unit markers in place of 2 unit markers and check for 2 markers/division, over the center eight divisions of display, to the tolerances given in Table 5-4.*

**TABLE 5-4**
**Sweep Timing**

| 5B25N TIME/DIV | Time MARKERS | Tolerance +15° to +35° C |
|---|---|---|
| .2 μs | .2 μs | Within 0.24 div |
| .5 μs | .5 μs | Within 0.24 div |
| 1 μs | 1 μs | Within 0.24 div |
| 2 μs | 2 μs | Within 0.24 div |
| 5 μs | 5 μs | Within 0.24 div |
| 10 μs | 10 μs | Within 0.24 div |
| 20 μs | 20 μs | Within 0.24 div |
| 50 μs | 50 μs | Within 0.24 div |
| .1 ms | .1 ms | Within 0.24 div |
| .2 ms | .2 ms | Within 0.24 div |
| .5 ms | .5 ms | Within 0.24 div |
| 1 ms | 1 ms | Within 0.24 div |
| 2 ms | 2 ms | Within 0.24 div |
| 5 ms | 5 ms | Within 0.24 div |
| 10 ms | 10 ms | Within 0.24 div |
| 20 ms | 20 ms | Within 0.24 div |
| 50 ms | 50 ms | Within 0.24 div |
| .1 s | .1 s | Within 0.24 div |
| .2 s | .2 s | Within 0.24 div |
| .5 s | .5 s | Within 0.24 div |
| 1 s | 1 s | Within 0.24 div |
| 2 s | 2 s | Within 0.32 div |
| 5 s | 5 s | Within 0.32 div |

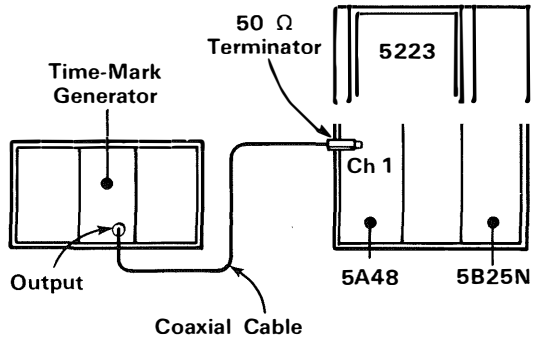
## B6. CHECK SINGLE SWEEP

**NOTE**

*If the preceding step was not performed, first perform step B1, then proceed.*

**B6. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 1 ms
- TRIGGERING
  - LEVEL/SENSITIVITY ..... To provide triggered display.




Test Equipment Controls:
- 5A48 Amplifier
  - Ch 1 Volts/Div ..... 1
  - Display ..... On
  - Trigger ..... Ch 1
- Time-Mark Generator
  - Markers ..... 1 ms

2813-545

a. Push the 5A48 Ch 1 Gnd button.

b. Press the 5B25N SINGLE SWEEP RESET button.

c. **CHECK**—that the SINGLE SWEEP READY indicator is lighted.

d. **CHECK**—that, when the 5A48 Ch 1 Gnd button is released, one sweep occurs and the SINGLE SWEEP READY indicator goes out.

e. Press the AUTO TRIGGERING MODE button on the 5B25N.

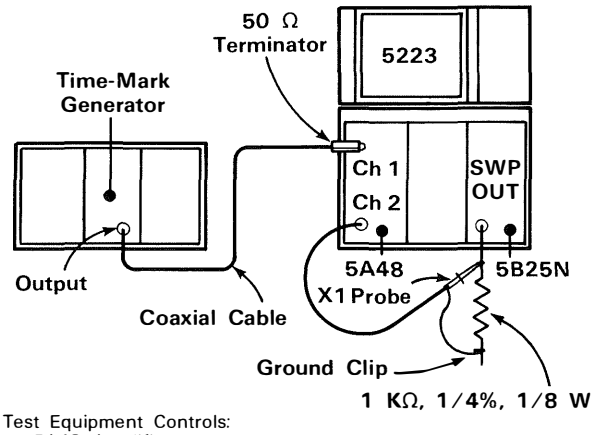
## B7. CHECK SWEEP OUT VOLTAGE

**NOTE**

*If the preceding step was not performed, first perform step B1, then proceed.*

**B7. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 1 ms
- TRIGGERING
  - SLOPE ..... +
  - COUPLING ..... AC
  - MODE ..... AUTO
  - SOURCE ..... LEFT




Test Equipment Controls:
- 5A48 Amplifier
  - Mode ..... ADD
  - Trigger ..... Ch 1
  - Input Coupling
    - Ch 1 ..... DC
    - Ch 2 ..... DC
  - Volts Div
    - Ch 1 ..... 2
    - Ch 2 ..... 0.1
- Time-Mark Generator
  - Markers ..... 1 ms
- 5223 Digitizing Oscilloscope
  - Left Memory Display ..... Pressed in
  - Intensity
    - Real Time ..... Off (fully counterclockwise)
    - Memory ..... For good display

2813-546

a. Adjust the LEVEL/SENSITIVITY for a triggered sweep.

b. Use the Vert and Horiz Posn controls on the 5223 to align the second time mark with a vertical graticule line. See Figure 5-2.

c. **CHECK**—that the 7th time mark aligns with the 7th horizontal graticule line, ±6% (0.42 division). Figure 5-2 shows the desired display.

d. Release 5223 Left Memory Display button and set real-time Intensity for a moderate-brightness display.



@

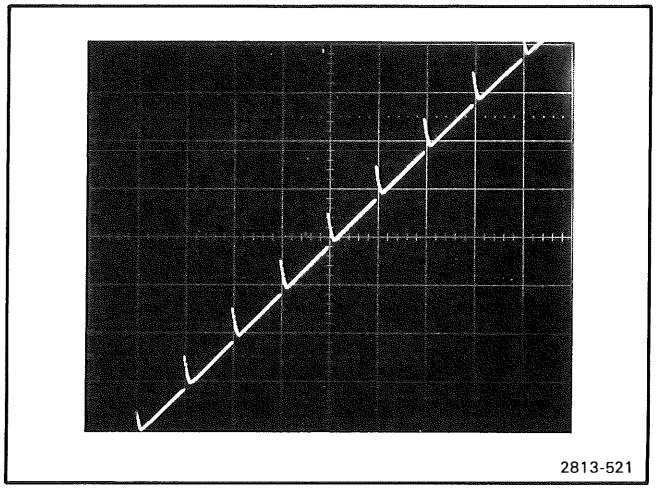



**Figure 5-2. Display of Sweep Out versus 1 ms time marks.**

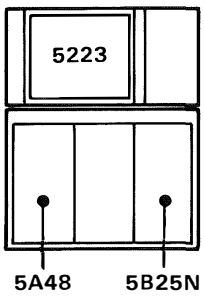
## B8. CHECK ALTERNATE AND CHOP

### NOTE

*If the preceding step was not performed, first perform step B1, then proceed.*

**B8. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 1 ms
- TRIGGERING
  - MODE ..... AUTO
- DISPLAY ..... ALTERNATE (button out)




Test Equipment Controls:
- 5A48 Amplifier
  - Display ..... On
  - Mode
    - Ch 1 ..... pressed
    - Ch 2 ..... pressed

2813-547

a. Use the 5A48 Position controls to move the two traces to convenient locations.

b. **CHECK**—that the two traces "flicker," which shows that they are alternating.

c. **CHECK**—that, when the 5B25N DISPLAY button is pressed in, the two traces are steady. This shows that the traces are being chopped.

d. Pull the 5A48 out (part way) to temporarily disconnect it.

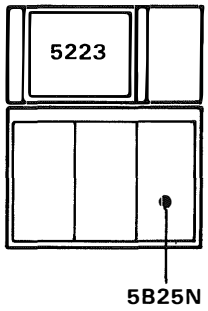
## B9. CHECK EXTERNAL SINGLE-SWEEP RESET

### NOTE

*If the preceding step was not performed, first perform step B1, then proceed.*

**B9. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 20 ms
- TRIGGERING
  - SOURCE ..... LINE




Test Equipment Controls:
- 5223 Digitizing Oscilloscope
  - Intensity ..... Set for visible display with 5B25N TRIGGERING MODE set to AUTO, then press SINGLE SWEEP button.

2813-548

a. Use the patch cord to short the lower two camera-power terminals. They are located on the left side of the crt bezel.

b. **CHECK**—that a single sweep occurs each time you short the lower two camera-power terminals.

c. Set 5B25N TRIGGERING MODE to AUTO.

# C. X10 SWEEP MAGNIFIER

**Equipment Required:** (Numbers correspond to those listed in Table 5-3, Test Equipment.)

1. 5223 Digitizing Oscilloscope
2. Dual-Trace Amplifier
5. Time-Mark Generator
6. Power Module Mainframe (for item 5)
8. Coaxial Cable (18-inch)
9. Terminator (50 Ω)

Shaded lines identify Performance Requirement CHECK.

## C1. X10 SWEEP MAGNIFIER PRELIMINARY SETUP

a. Perform the Performance Check Power-Up sequence, which appears at the beginning of Part I, Performance Check.

b. Refer to Section 6, Instrument Options, and the Change Information section at the back of this manual for any changes which may affect this procedure.

c. Set the 5B25N controls as follows:

TIME/DIV ..... 1 ms
TRIGGERING
  SLOPE ..... +
  LEVEL/SENSITIVITY ..... Centered
  COUPLING ..... AC
  MODE ..... AUTO
  SOURCE ..... LEFT
DISPLAY ..... In (CHOP)
POSITION ..... Centered
X10 SWP MAG ..... Out (X1)
PRETRIGGER ..... 0%

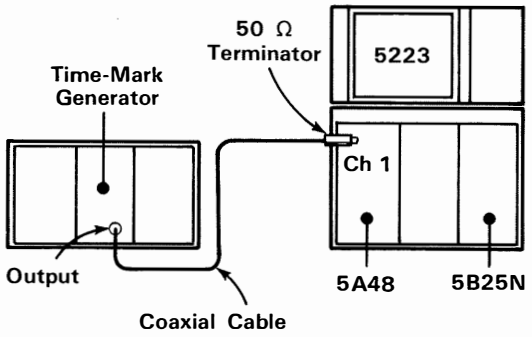
## C2. CHECK MAG GAIN

**NOTE**

*First perform step C1, then proceed.*

**C2. SETUP CONDITIONS**

5B25N Controls:
Make no changes to the control settings.




Test Equipment Controls:
5A48 Amplifier
  Ch 1 Volts/Div ..... 1
  Display ..... On
  Trigger ..... Ch 1
  Mode ..... Ch 1
Time-Mark Generator
  Markers ..... 0.1 ms

2813-522

a. Observe display—verify that sweep is triggered. If necessary, adjust TRIGGERING LEVEL/SENSITIVITY control.

b. Press the X10 SWP MAG button.

c. **CHECK**—that X10 SWP MAG button is lighted.

d. **CHECK**—display for one marker per major graticule division, ±4% (±0.32 division over center eight divisions).

e. Release X10 SWP MAG button.

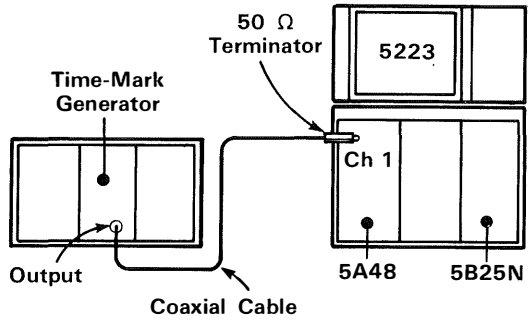
## C3. CHECK TIMING & LINEARITY OF MAGNIFIED SWEEP

**NOTE**

*If the preceding step was not performed, first perform step C1, then proceed.*

**C3. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 0.2 μs




Test Equipment Controls:
5A48 Amplifier
Ch 1 Volts/Div ..... 0.2
Display ..... On
Trigger ..... Ch 1

Time-Mark Generator
Markers ..... 20 ns

2813-523

a. Observe display to verify if sweep is triggered. If necessary, adjust the TRIGGERING LEVEL/SENSITIVITY control.

b. Press the X10 SWP MAG button.

c. **CHECK**—that the display shows one cycle per division ±4% (0.32 division over the center eight divisions) over full sweep, except for the first 200 ns (the first 10 divisions at 20 ns/div) and anything past 105 divisions.

d. **CHECK**—timing and linearity of magnified sweep at 0.5 μs and 1 μs over the full sweep, as shown in Table 5-5.

e. Release the X10 SWP MAG button.

**TABLE 5-5**
**Magnified Sweep Timing and Linearity**

| 5B25N TIME/DIV | Time Marks | Allowable Error Over Center 8 Divisions | Remarks |
|---|---|---|---|
| .5 μs | 50 ns | ±0.32 div (4%) | First 200 ns is 4 div. |
| 1 μs | .1 μs | ±0.32 div (4%) | First 200 ns is 2 div. |

# D. EXTERNAL HORIZONTAL

**Equipment Required:** (Numbers correspond to those listed in Table 5-3, Test Equipment).

1. 5223 Digitizing Oscilloscope
2. Dual-Trace Amplifier
3. Calibration Generator
6. Power Module Mainframe (for item 3)
8. Coaxial Cable (18-inch)
9. Terminator (50 Ω)

Shaded lines identify Performance Requirement CHECK.

## D1. EXTERNAL HORIZONTAL PRELIMINARY SETUP

a. Perform the Performance Check Power-Up Sequence, which appears at the beginning of Part I, Performance Check.

b. Refer to Section 6, Instrument Options, and to the Change Information section at the back of this manual for any changes which may affect this procedure.

c. Set the 5B25N controls as follows:

TIME/DIV ..... 1 ms
TRIGGERING
  SLOPE ..... +
  LEVEL/SENSITIVITY ..... Fully clockwise
  COUPLING ..... AC
  MODE ..... AUTO
  SOURCE ..... LEFT
DISPLAY ..... In (CHOP)
POSITION ..... Centered
X10 SWP MAG ..... Out (X1)
PRETRIGGER ..... 0%

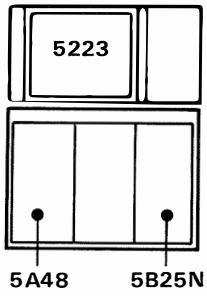
## D2. CHECK EXTERNAL HORIZONTAL BALANCE

**NOTE**

*First perform step D1, then proceed.*

**D2. SETUP CONDITIONS**

5B25N Controls:
Make no changes to the control settings.




Test Equipment Controls:
5A48 Amplifier
Display ..... On

2813-524

a. Use the 5B25N POSITION control to set the left end of the trace to the zero graticule line.

b. Set the TIME/DIV control to the AMPL position. (Keep the 5223 Intensity control at a moderate-to-low setting to avoid burning the crt.)

c. Press the TRIGGERING EXT SOURCE button.

d. **CHECK**—that the beam is within four horizontal divisions of graticule center.



@

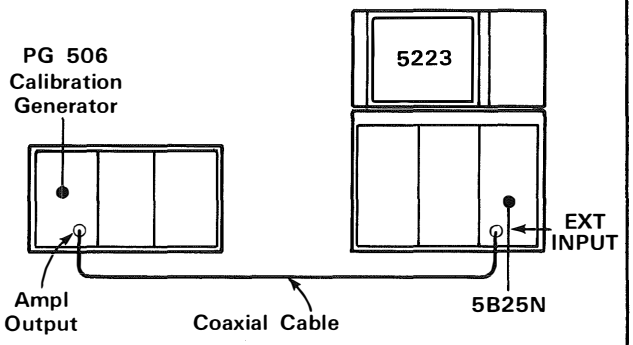
## D3. CHECK EXTERNAL HORIZONTAL GAIN

**NOTE**

*If the preceding step was not performed, first perform step D1, then proceed.*

**D3. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... AMPL
- TRIGGERING
  - COUPLING ..... DC
  - SOURCE ..... EXT




Test Equipment Controls:
- Calibration Generator (PG 506)
  - Mode ..... Std Ampl
  - Amplitude ..... 0.2 V

2813-525

a. Use the 5B25N POSITION control to set the left dot to a vertical graticule line.

b. **CHECK**—that the dots are four horizontal divisions apart ±3% (±0.12 division).

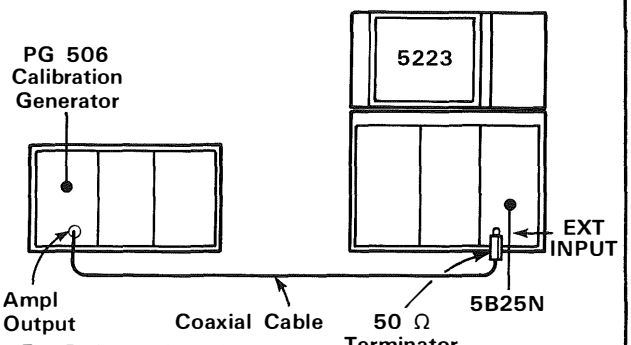
## D4. CHECK EXTERNAL HORIZONTAL COMPENSATION

**NOTE**

*If the preceding step was not performed, first perform step D1, then proceed.*

**D4. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... AMPL
- TRIGGERING
  - COUPLING ..... DC
  - SOURCE ..... EXT




Test Equipment Controls:
- Calibration Generator (PG 506)
  - Mode ..... High Ampl
  - Pulse Amplitude ..... To produce 6 divisions of deflection on crt.
  - Period ..... 1 ms

2813-526

a. Verify that the horizontal deflection between the two dots is six divisions. If necessary, adjust the Pulse amplitude of the Calibration Generator.

b. **CHECK**—that "tail" on right-hand dot is 0.3 division or less (5% of 6 divisions deflection).

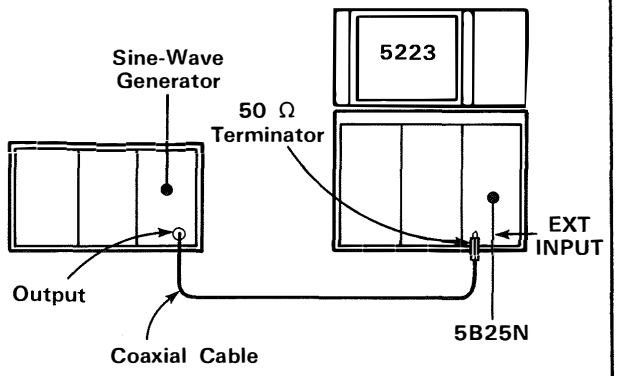
## D5. CHECK BANDWIDTH OF EXTERNAL HORIZONTAL CHANNEL

**NOTE**

*First perform step D4, then proceed.*

**D5. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... AMPL
- TRIGGERING
  - COUPLING ..... DC
  - SOURCE ..... EXT




Test Equipment Controls:
- Sine-Wave Generator
  - Frequency ..... 50 kHz
  - Output Amplitude ..... To cause a 6-division horizontal display.

2813-537

a. Use the 5B25N POSITION control to align the horizontal display with vertical graticule lines that are 6 divisions apart.

b. Set the frequency of the Sine-Wave Generator to 2.0 MHz.

c. **CHECK**—that the horizontal display is at least 4.2 divisions long.

# E. DIGITIZER-RELATED FUNCTIONS

**Equipment Required:** (Numbers correspond to those listed in Table 5-3, Test Equpment.)

1. 5223 Digitizing Oscilloscope
2. Dual-Trace Amplifier
3. Calibration Generator
4. Sine-Wave Generator
5. Time-Mark Generator
6. Power Module mainframe (for items 3, 4, 5)
8. Coaxial Cables (18-inch and 42-inch)
9. Terminator (50 Ω)
11. Connector (bnc T)
12. Patch Cord

Shaded lines identify Performance Requirement CHECK.

## E1. DIGITIZER-RELATED FUNCTIONS PRELIMINARY SETUP

a. Perform the Performance Check Power-Up Sequence, which appears at the beginning of Part I, Performance Check.

b. Refer to Section 6, Instrument Options, and to the Change Information section at the back of this manual for any changes which may affect this procedure.

c. Set the 5B25N controls as follows:

TIME/DIV ..... 0.5 ms
TRIGGERING
  SLOPE ..... +
  LEVEL/SENSITIVITY ..... Centered
  COUPLING ..... AC
  MODE ..... AUTO
  SOURCE ..... LEFT
DISPLAY ..... In (CHOP)
POSITION ..... Centered
X10 SWP MAG ..... Off (button out)
PRETRIGGER ..... 0%

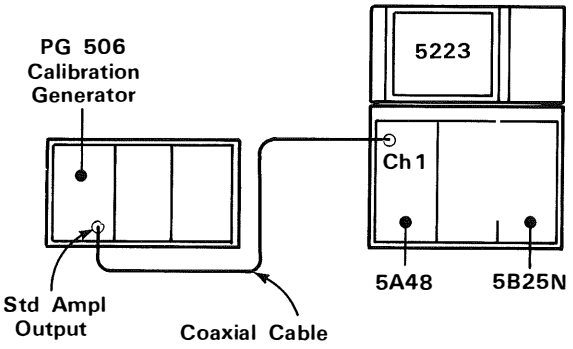
## E2. CHECK VCO FAST

**NOTE**

*First perform step E1, then proceed.*

**E2. SETUP CONDITIONS**

5B25N Controls:
Make no changes to the control settings.




Test Equipment Controls:
5A48 Amplifier
  Mode ..... Ch 1
  Trigger ..... Ch 1
  Input Coupling ..... DC
  Ch 1 Volts/Div ..... 1
  Display ..... On

5223 Digitizing Oscilloscope
  Memory Contents
    Left Vert Plug-In Display ..... Pressed in
    Vert Exp ..... X1
    Horiz Exp ..... X1

Calibration Generator (PG 506)
  Amplitude ..... 2 V
  Output Selector ..... Std Ampl

2813-527

a. Verify that the sweep is triggered. If necessary, adjust the LEVEL/SENSITIVITY control to trigger the sweep.

b. Adjust the 5223 Intensity and Mem Inten controls for good displays.

c. Move the 5B25N Variable TIME/DIV control just out of its detent.

d. Adjust the 5223 Memory Vert and Horiz Posn Controls to bring the memory display to the same starting point as the real-time display.

e. Use the 5B25N POSITION control to set the starting points of the traces to the left-most graticule line.

f. **CHECK**—That the two waveforms match within ±5% (±0.45 division at the ninth graticule line).

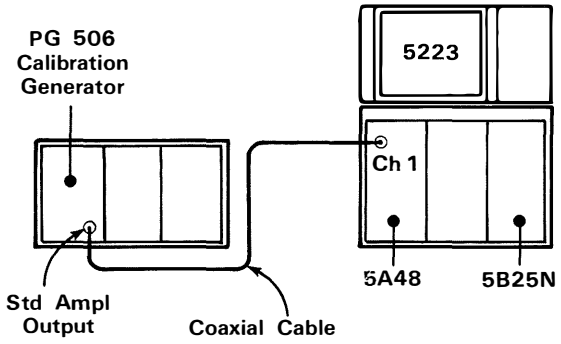
## E3. CHECK VCO SLOW

**NOTE**

*If the preceding step was not performed, first perform step E1, then proceed.*

**E3. SETUP CONDITIONS**

5B25N Controls:
Make no changes to the setup conditions.




Test Equipment Controls:
5A48 Amplifier
Mode ..... Ch 1
Trigger ..... Ch 1
Input Coupling ..... DC
Ch 1 Volts/Div ..... 1
Display ..... On

5223 Digitizing Oscilloscope
Memory Contents
Left Vert Plug-In Display ..... Pressed in
Vert Exp ..... X1
Horiz Exp ..... X1

Calibration Generator (PG 506)
Amplitude ..... 2 V
Output Selector ..... Std Ampl

2813-528

a. Turn the 5B25N Variable TIME/DIV control to the counterclockwise extreme of its rotation.

b. Verify that the sweep is triggered. If necessary, adjust the LEVEL/SENSITIVITY control to trigger the sweep.

c. Adjust the 5223 Memory Vert and Horiz Posn controls to bring the memory display to the same starting point as the real-time display.

d. Use the 5B25N POSITION control to set the starting points of the traces to the left-most graticule line.

e. **CHECK**—That the two waveforms match within ±5% (±0.45 division at the ninth graticule line).

f. Return the Variable TIME/DIV control to the calibrated position (in the detent).

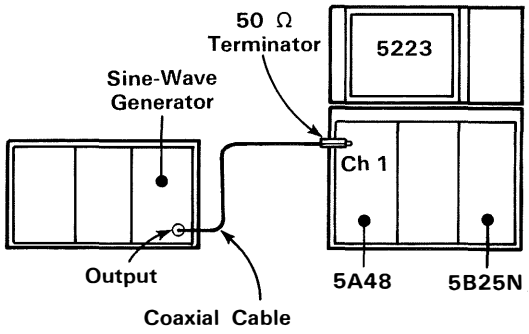
## E4. CHECK SAMPLE ZERO

**NOTE**

*If the preceding step was not performed, first perform step E1, then proceed.*

**E4. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 5 μs




Test Equipment Controls:
5A48 Amplifier
Mode ..... Ch 1
Trigger ..... Ch 1
Input Coupling ..... DC
Ch 1 Volts/Div ..... 1
Display ..... On

5223 Digitizing Oscilloscope
Memory Contents
Left Vert Plug-In Display ..... Pressed in
Vert Exp ..... X1
Horiz Exp ..... X1

Sine-Wave Generator
Frequency ..... 50 kHz
Amplitude ..... To cause a 3-division display

2813-529



@

a. Verify that the sweep is triggered. If necessary, adjust the LEVEL/SENSITIVITY control.

b. **CHECK**—the start of the memory display. It should look just like the real-time display, with no horizontal bar before the sine wave.

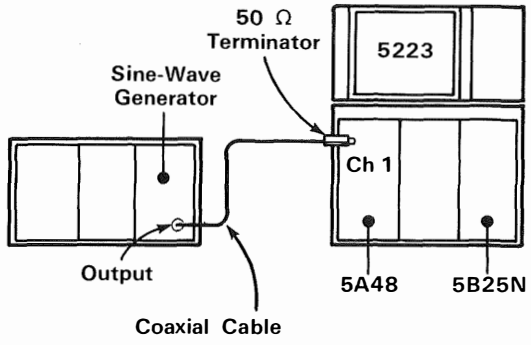
## E5. CHECK SAMPLE FULL-SCALE

### NOTE

*If the preceding step was not performed, first perform step E1, then proceed.*

**E5. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 10 μs




Test Equipment Controls:
5A48 Amplifier
Mode ..... Ch 1
Trigger ..... Ch 1
Input Coupling ..... DC
Ch 1 Volt/Div ..... 1
Display ..... On

5223 Digitizing Oscilloscope
Memory Contents
Left Vert Plug-In Display ..... Pressed in
Vert Exp ..... X1
Horiz Exp ..... X1

Sine-Wave Generator
Frequency ..... 50 kHz
Amplitude ..... To cause a 3-division display.

2813-530

a. Verify that the sweep is triggered. If necessary, adjust the LEVEL/SENSITIVITY control.

b. Use the 5223 Vert and Horiz Posn controls to superimpose the memory display on the real-time display.

c. **CHECK**—the two displays to see if they match horizontally, ±4% (±0.32 division) over the center eight divisions.

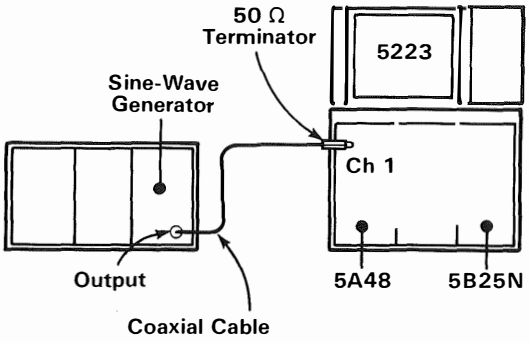
## E6. CHECK HIGH RATE COMPENSATION

### NOTE

*If the preceding step was not performed, first perform step E1, then proceed.*

**E6. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 0.2 μs




Test Equipment Controls:
5A48 Amplifier
Mode ..... Ch 1
Trigger ..... Ch 1
Input Coupling ..... DC
Ch 1 Volts/Div ..... 0.5
Display ..... On

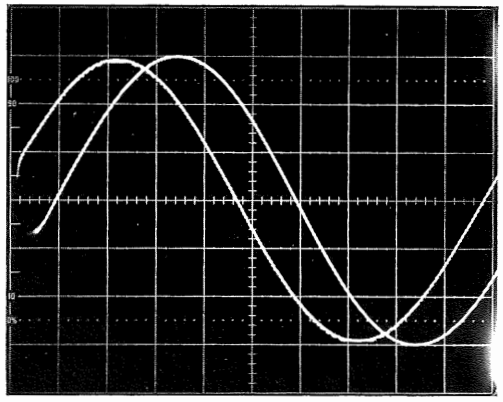
5223 Digitizing Oscilloscope
Memory Contents
Left Vert Plug-In Display ..... Pressed in
Vert Exp ..... X1
Horiz Exp ..... X1

Sine-Wave Generator
Frequency ..... 500 kHz
Amplitude ..... To cause a 6-division display.

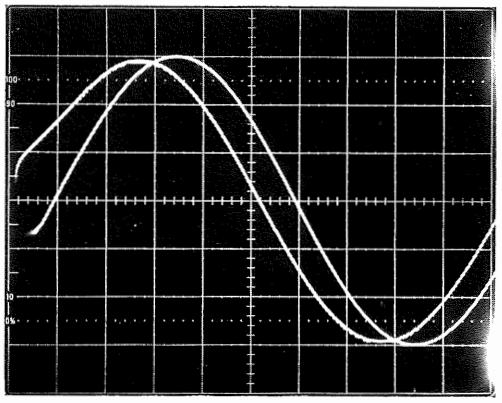
2813-531

a. Adjust the LEVEL/SENSITIVITY control so that the sweep starts at the mid-point of the waveform.

b. **CHECK**—that the positive-going slope of the first half-cycle of the displayed waveform is the same as the slope of the real-time waveform. Figure 5-3 shows correct and incorrect displays.



A. Correct compensation.



B. Incorrect compensation.

2813-541

Figure 5-3. Displays or correct and incorrect High Rate Compensation.

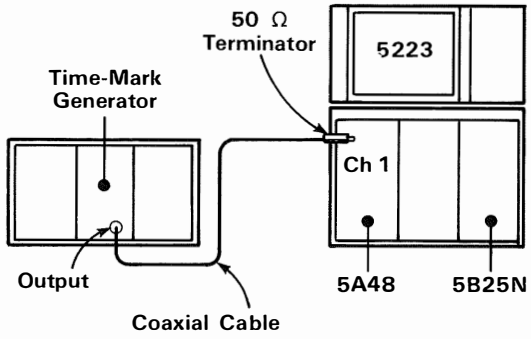
## E7. CHECK POSSIBLE UNDERSAMPLING INDICATOR

**NOTE**

*If the preceding step was not performed, first perform step E1, then proceed.*

**E7. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 0.1 ms




Test Equipment Controls:
5A48 Amplifier
Mode ..... Ch 1
Trigger ..... Ch 1
Input Coupling ..... DC
Ch 1 Volts/Div ..... 1
Display ..... On

Time-Mark Generator
Markers ..... 0.1 ms

2813-533

a. Verify that the sweep is triggered. If necessary adjust the LEVEL/SENSITIVITY control.

b. **CHECK**—that the POSSIBLE UNDERSAMPLING indicator is not lighted.

c. Change the Time-Mark Generator to produce 10 μs markers.

d. **CHECK**—that the POSSIBLE UNDERSAMPLING indicator is not lighted.

e. Set the Time-Mark Generator to produce 5 μs markers.

f. **CHECK**—that the POSSIBLE UNDERSAMPLING indicator is lighted.



@

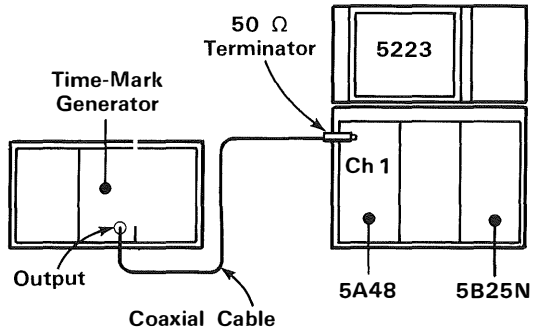
## E8. CHECK PRETRIGGER FUNCTION

**NOTE**

*If the preceding step was not performed, first perform step E1, then proceed.*

**E8. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 0.2 ms




Test Equipment Controls:
5A48 Amplifier
Mode ..... Ch 1
Trigger ..... Ch 1
Input Coupling ..... DC
Ch 1 Volts/Div ..... 1
Display ..... On

Time-Mark Generator
Markers ..... 0.2 ms

5223 Digitizing Oscilloscope
Left Vert Plug-In Display ..... Pressed in
Vert Exp ..... X1
Horiz Exp ..... X1

2813-534

a. Verify that the sweep is triggered. If necessary, adjust the LEVEL/SENSITIVITY control.

b. Release the 5A48 Display button.

c. Adjust the 5223 Mem Inten control for a low-brightness display. The low-brightness display makes it easier to see the point where the trigger event occurs, because the pretrigger time has a medium-brightness display.

d. Use the 5223 Horiz Posn control to set the right end of the memory display to the right-most line on the crt graticule.

e. Move the PRETRIGGER control out of its detent.

f. **CHECK**—that, by rotating the PRETRIGGER control from its "just-out-of-detent" position to fully counterclockwise, the intensified part of the display can be brought to the right end of the memory display.

g. Set the PRETRIGGER control to the 0% position-in the detent.

h. Set the TIME/DIV control to 0.5 s.

i. Set the Time Mark Generator to 0.5 s.

j. Press the NORM TRIGGERING MODE button.

k. Press the 5A48 Display button.

l. Verify that the 5B25N is triggered. If necessary, adjust the LEVEL/SENSITIVITY control.

m. **CHECK**—that the real-time and memory displays match and that the memory display updates after each real-time sweep.

n. Set the TIME/DIV control to 0.2 s.

o. **CHECK**—that the real-time and memory displays match and that the memory display updates after each real-time sweep.

p. Set the TIME/DIV control to 0.1 s.

q. **CHECK**—that the real-time and memory displays match and that the memory display updates after each real-time sweep.

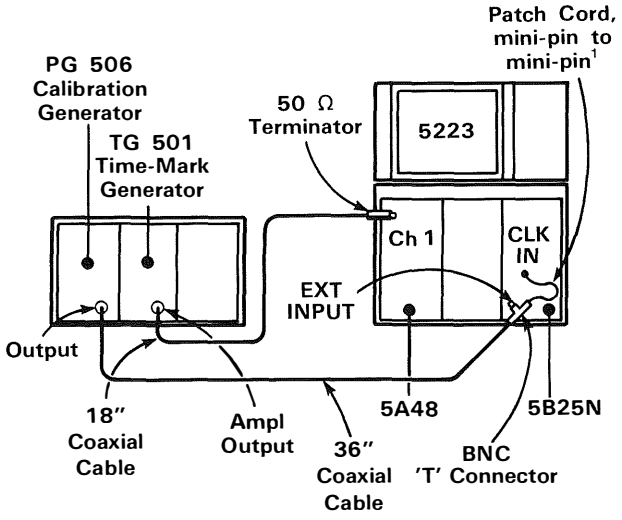
## E9. CHECK EXTERNAL SAMPLE CLOCK IN FUNCTION

**NOTE**

*If the preceding step was not performed, first perform step E1, then proceed.*

**E9. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 1 ms
- SAMPLE CLK SOURCE ..... NORMAL (Pressed in)




Test Equipment Controls:

5A48 Amplifier
- Mode ..... Ch 1
- Trigger ..... Ch 1
- Input Coupling ..... DC
- Ch 1 Volts/Div ..... 1
- Display ..... On

Time-Mark Generator (TG 501)
- Markers ..... 1 ms

5223 Digitizing Oscilloscope
- Left Vert Plug-In Display ..... Pressed in
- Vert Exp ..... X1
- Horiz Exp ..... X1
- Intensity ..... For good display
- Mem Inten ..... For good display

Calibration Generator (PG 506)
- Output Selector ..... Std Ampl
- Amplitude ..... 5 V

[1]Insert one end of the patch cord into the center female pin of the bnc 'T' connector, and the other end into the 5B25N's CLK IN jack.

2813-535

a. Verify that the sweep is triggered. If necessary, adjust the LEVEL/SENSITIVITY control.

b. Set the TIME/DIV control to 0.1 s.

c. Press the 5223 Memory Contents Roll button.

d. Pull the SAMPLE CLK SOURCE button out. (This is also the Variable TIME/DIV control.)

e. **CHECK**—for time marks moving from right to left across the crt. Figure 5-4 shows a typical display.

f. Release the Memory Contents Roll button and press the SAMPLE CLK SOURCE button in.

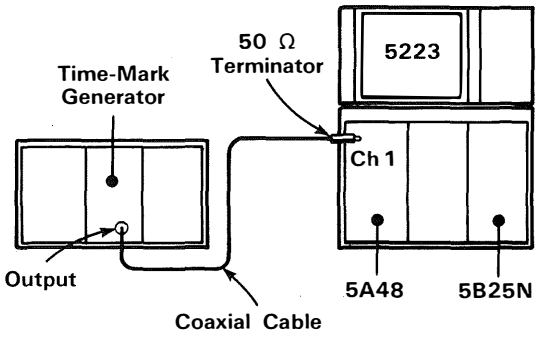
## E10. CHECK SINGLE-SWEEP LOAD STOP DISQUALIFYING

**NOTE**

*If the preceding step was not performed, first perform step E1, then proceed.*

**E10. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 0.2 s
- TRIGGERING
  - MODE ..... AUTO
- PRETRIGGER ..... 100%




Test Equipment Controls:

5A48 Amplifier
- Ch 1 Volts/Div ..... 1
- Mode ..... Ch 1
- Trigger ..... Ch 1
- Input Coupling ..... DC
- Display ..... On

5223 Digitizing Oscilloscope
- Left Vert Plug-In Display ..... Pressed in
- Vert Exp ..... X1
- Horiz Exp ..... X1
- Intensity ..... For good display
- Mem Inten ..... For good display

Time-Mark Generator
- Markers ..... 0.1 s

2813-539

a. Press the 5B25N SINGLE SWEEP RESET button.

b. Push the SINGLE SWEEP RESET button to start a sweep; then press it again before it reaches mid-trace.

c. **CHECK**—that the memory display is updated each time a new sweep starts in response to an input from the SINGLE SWEEP RESET button.

d. Set the 5B25N TRIGGERING MODE to AUTO.

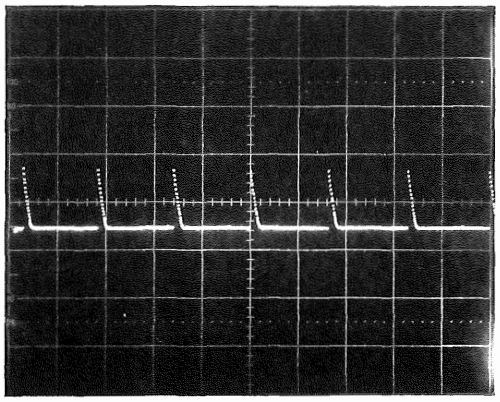



**Figure 5-4. Typical display of time marks while checking External Sample Clock In function.**

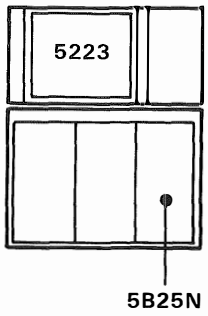
## E11. CHECK ROLL DISABLE

**NOTE**

*If the preceding step was not performed, first perform step E1, then proceed*

**E11. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 50 ms




Test Equipment Controls:
5223 Digitizing Oscilloscope
Roll ..... Pressed in

2813-540

a. **CHECK**—that the 5223 Memory Contents Roll pushbutton lights when the 5B25N TIME/DIV control is moved from 50 ms to 0.1 s.

b. Release the 5223 Memory Contents Roll and Left Vert Plug-In Display buttons.

This concludes the Performance Check.

# PART II—ADJUSTMENT AND PERFORMANCE CHECK

The following procedure (Part II—Adjustment and Performance Check) provides the information necessary to: (1) verify that the instrument meets the electrical specifications, (2) verify that the controls function properly, and (3) perform all internal adjustments.

Part I—Performance Check verifies electrical specifications without making internal adjustments. All tolerances given are as specified in the Specification tables (section 1) in this manual).

A separate Checkout Procedure is provided in section 2 to provide instrument familiarization and to verify that the controls function properly.

See Table 5-1, Calibration Procedure Electives, at the beginning of this section, for information on performing a Partial Part I—Performance Check procedure.

## INDEX TO PART II—ADJUSTMENT AND PERFORMANCE CHECK



## ADJUSTMENT AND PERFORMANCE CHECK POWER-UP SEQUENCE

**NOTE**

*The performance of this instrument can be checked at any ambient temperature from 0° to +50° C unless otherwise stated. Adjustments must be performed at an ambient temperature from +15° to +25° C for specified accuracies.*

1. Remove the left and right shields to gain access to the internal controls and test points.

2. Remove the shields from the right side and from the bottom of the 5223 plug-in compartment.

3. Install the 5B25N in the right-hand plug-in compartment of the 5223 mainframe.

4. Install a 5A48, or its equivalent, in the left-hand vertical plug-in compartment of the mainframe.

5. Switch on the mainframe and appropriate test equipment and allow at least 20 minutes warmup time before proceeding.

# A. TRIGGERING

**Equipment Required:** (Numbers correspond to those listed in Table 5-3, Test Equipment.)

1. 5223 Digitizing Oscilloscope
2. Dual-Trace Amplifier
4. Sine-Wave Generator
5. Time-Mark Generator
6. Power Module Mainframe (for items 4, 5)
7. Dual-Input Coupler
8. Coaxial Cable (18-inch)
9. Terminator (50 Ω)

Shaded lines identify Performance Requirement CHECK.

## A1. TRIGGERING PRELIMINARY SETUP

a. Perform the Adjustment and Performance Check Power-Up Sequence, which appears at the beginning of Part II, Adjustment and Performance Check.

b. Refer to Section 6, Instrument Options, and to the Change Information section at the back of this manual for any changes which may affect this procedure.

c. See the TEST POINT AND ADJUSTMENT LOCATIONS pages in Section 8, Diagrams and Circuit Board Illustrations.

d. Set the 5B25N controls as follows:

TIME/DIV ..... 10 μs
TRIGGERING
  SLOPE ..... ±
  LEVEL/SENSITIVITY ..... Fully clockwise
  COUPLING ..... AC
  MODE ..... AUTO
  SOURCE ..... LEFT
DISPLAY ..... In (CHOP)
POSITION ..... Centered
X10 SWP MAG ..... Off (button out)
PRETRIGGER ..... 0%

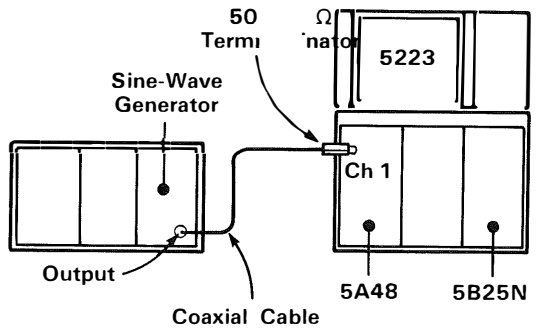
## A2. EXAMINE/ADJUST BISLOPE TRIGGERING

**NOTE**

*First perform step A1, then proceed.*

**A2. SETUP CONDITIONS**

5B25N Controls:
Make no changes to the control settings.




Test Equipment Controls:
Sine-Wave Generator
Frequency ..... 50 kHz
Amplitude ..... To produce 1 division of deflection on crt

5A48 Amplifier
Ch 1 Volts/Div ..... 1
Display ..... On
Trigger ..... Ch 1
Mode ..... Ch 1

2814-501

a. Center the display with the Ch 1 Position control on the 5A48 Amplifier.

b. Move the LEVEL/SENSITIVITY control to its MAX position, which is fully counterclockwise.

c. Press the CH 1 Gnd button on the 5A48.

d. If necessary, adjust the 5A48 Ch 1 Position control to center the trace.

e. Release the Ch 1 Gnd button.

f. The display should show two sine waves, one triggered on its + slope and one triggered on its − slope. If there is only one, adjust the Variable TIME/DIV control until two sine waves appear.

g. **EXAMINE**—the two waveforms to see if their starting points are equidistant from the horizontal center line. Figure 5-5 shows the desired display.

h. **ADJUST**—± Slope Bal (R29) to set the starting points of the two waveforms equal distances from the horizontal center graticule line.

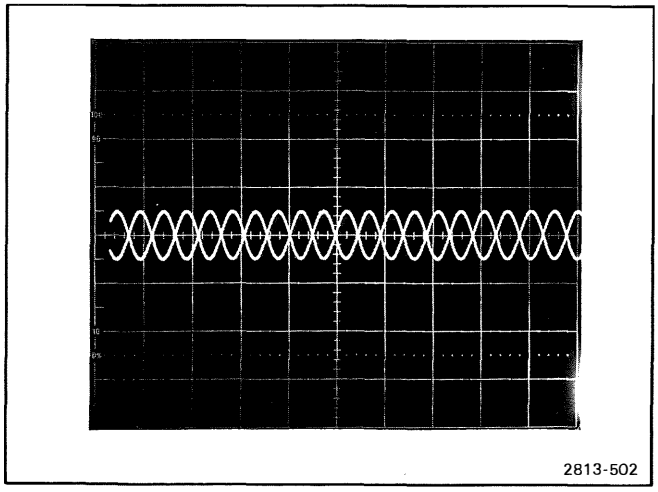



**Figure 5-5. Display of bislope triggering.**

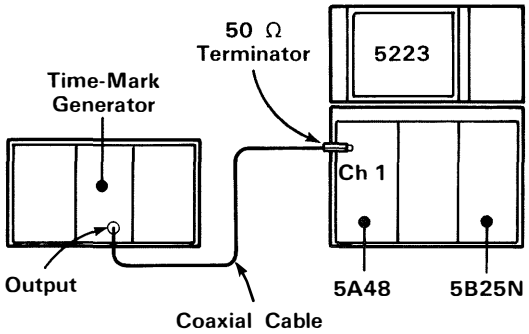
## A3. CHECK AUTO RECOVERY

**NOTE**

*If the preceding step was not performed, first perform step A1, then proceed.*

**A3. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 20 ms
- Variable ..... In CAL detent
- TRIGGERING
- SLOPE ..... +
- LEVEL/SENSITIVITY ..... For triggered sweep




Test Equipment Controls:
- Time-Mark Generator
- Markers ..... 50 ms intervals

5A48 Amplifier
- Ch 1 Volts/Div ..... 1
- Display ..... On
- Trigger ..... Ch 1

2813-503

a. **CHECK**—that sweep is triggered.

b. Set Time-Mark Generator to produce 0.5 s time marks.

c. **CHECK**—that sweep is not triggered.

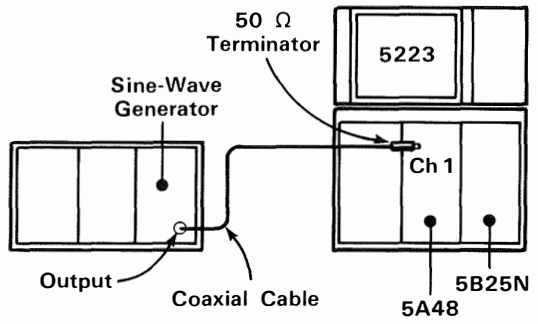
## A4. CHECK 1 MHz TRIGGERING

**NOTE**

*If the preceding step was not performed, first perform step A1, then proceed.*

**A4. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 2 μs
- TRIGGERING
  - COUPLING ..... AC
  - MODE ..... AUTO
  - SOURCE ..... RIGHT
  - SLOPE ..... +




Test Equipment Controls:

5A48 Amplifier
- Ch 1 Volts/Div ..... 1
- Display ..... On
- Trigger ..... Ch 1

Sine-Wave Generator
- Frequency ..... 1 MHz
- Amplitude ..... To produce 0.4 division of crt deflection.

2813-504

a. Verify that the input signal causes 0.4 division of deflection on the crt.

b. Press the 5B25N RIGHT TRIGGERING SOURCE button.

c. **CHECK**—that by adjusting the LEVEL/SENSITIVITY control, the sweep will trigger and produce a stable display.

d. **CHECK**—that the TRIG'D indicator is lighted.

e. Set TRIGGERING SLOPE to −.

f. **CHECK**—that by adjusting the LEVEL/SENSITIVITY control, the sweep will trigger and produce a stable display.

g. **CHECK**—that the TRIG'D indicator is lighted.

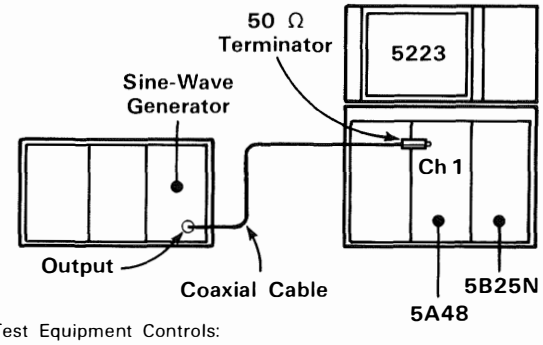
## A5. CHECK 15 MHz TRIGGERING

**NOTE**

*If the preceding step was not performed, first perform step A1, then proceed.*

**A5. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 0.2 μs
- TRIGGERING
  - COUPLING ..... AC
  - MODE ..... AUTO
  - SOURCE ..... RIGHT
  - SLOPE ..... +




Test Equipment Controls:

5A48 Amplifier
- Ch 1 Volts/Div ..... 1
- Display ..... On
- Trigger ..... Ch 1

Sine-Wave Generator
- Frequency ..... 15 MHz
- Amplitude ..... To produce 0.6 div deflection on crt.

2813-505

a. Verify that the 15 MHz input signal causes 0.6 division of deflection on the crt.

b. **CHECK**—that by adjusting the LEVEL/SENSITIVITY control the sweep will trigger and produce a stable display.

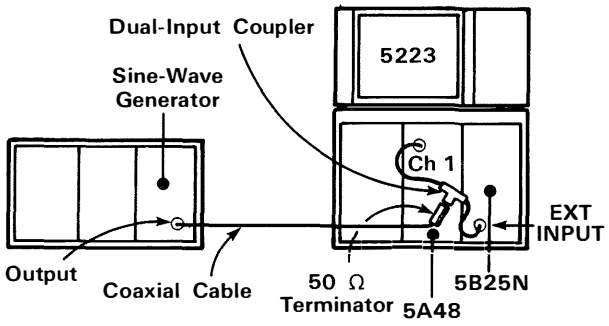
## A6. CHECK 15 MHz EXTERNAL TRIGGERING

**NOTE**

*If the preceding step was not performed, first perform step A1, then proceed.*

**A6. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 0.2 μs
- TRIGGERING
  - COUPLING ..... AC
  - MODE ..... AUTO
  - SOURCE ..... EXT
  - SLOPE ..... +




Test Equipment Controls:
- 5A48 Amplifier
  - Ch 1 Volts/Div ..... 0.1
  - Display ..... On
- Sine-Wave Generator
  - Frequency ..... 15 MHz
  - Amplitude ..... To produce 2 divisions of deflection on crt.

2813-506

a. Verify that the 15 MHz input signal causes 2.0 divisions of deflection on the crt.

b. **CHECK**—that adjusting the LEVEL/SENSITIVITY control causes the sweep to trigger and produce a stable display.

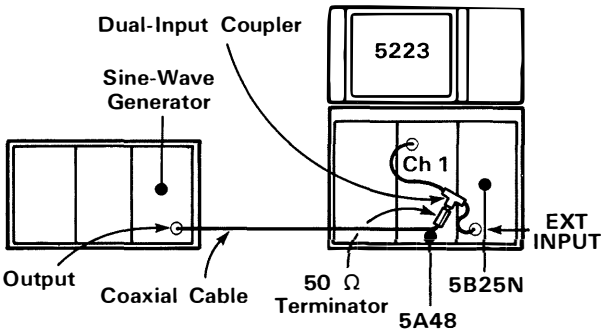
## A7. CHECK 1 MHz EXTERNAL TRIGGERING

**NOTE**

*If the preceding step was not performed, first perform step A1, then proceed.*

**A7. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 1 μs
- TRIGGERING
  - COUPLING ..... AC
  - MODE ..... AUTO
  - SOURCE ..... EXT
  - SLOPE ..... +




Test Equipment Controls:
- Sine-Wave Generator
  - Frequency ..... 1 MHz
  - Amplitude ..... To produce 0.5 division of deflection on crt.
- 5A48 Amplifier
  - Ch 1 Volts/Div ..... 0.1
  - Display ..... On

2513-507

a. Verify that the 1 MHz input signal causes 0.5 division of deflection on the crt.

b. **CHECK**—that adjusting the LEVEL/SENSITIVITY control causes the sweep to trigger and produce a stable display.

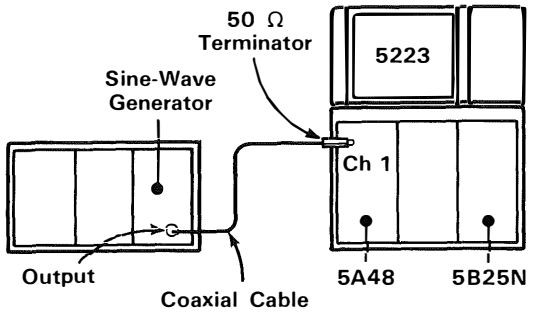
## A8. CHECK TRIGGERING SLOPE

**NOTE**

*If the preceding step was not performed, first perform step A1, then proceed.*

**A8. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 10 μs
- TRIGGERING
  - COUPLING ..... AC
  - MODE ..... AUTO
  - SOURCE ..... LEFT
  - SLOPE ..... +




Test Equipment Controls:
- 5A48 Amplifier
  - Ch 1 Volts/Div ..... 0.1
  - Display ..... On
  - Trigger ..... Ch 1
- Sine-Wave Generator
  - Frequency ..... 50 kHz
  - Amplitude ..... To produce 1 division of deflection on crt.

2813-508

a. **CHECK**—that adjusting the LEVEL/SENSITIVITY control causes the sweep to trigger on the positive-going slope of the input signal.

b. Set the SLOPE control to −.

c. **CHECK**—that adjusting the LEVEL/SENSITIVITY control causes the sweep to trigger on the negative-going slope of the input signal.

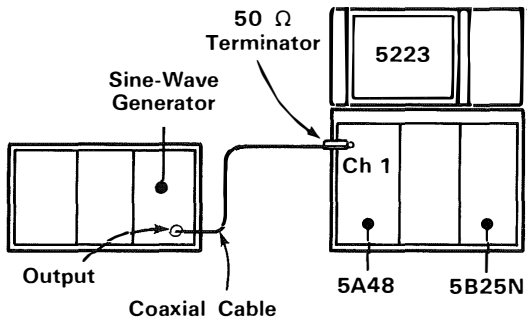
## A9. CHECK TRIGGERING COUPLING

**NOTE**

*If the preceding step was not performed, first perform step A1, then proceed.*

**A9. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 10 μs
- TRIGGERING
  - COUPLING ..... DC
  - MODE ..... AUTO
  - SOURCE ..... LEEFT
  - SLOPE ..... +




Test Equipment Controls:
- Sine-Wave Generator
  - Frequency ..... 50 kHz
  - Amplitude ..... To produce 1 division of deflection on crt.
- 5A48 Amplifier
  - Ch 1 Volts/Div ..... 0.1
  - Display ..... On
  - Trigger ..... Ch 1

2813-509

a. Set the LEVEL/SENSITIVITY control so that the trigger point is at center of the waveform.

b. **CHECK**—that pressing the AC COUPLING button causes the trigger point (start of display) to move or causes the sweep to free-run.

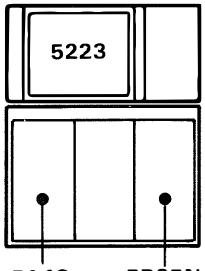
## A10. CHECK LINE TRIGGERING

**NOTE**

*If the preceding step was not performed, first perform step A1, then proceed.*

**A10. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 1 ms
- TRIGGERING
  - COUPLING ..... AC
  - MODE ..... NORM
  - SOURCE ..... LINE
  - SLOPE ..... +
  - LEVEL/SENSITIVITY ..... Centered




Test Equipment Controls:
- 5A48 Amplifier
  - Position ..... To put trace on screen.
  - Display ..... On

2813-510

a. **CHECK**—that the trace is present on the screen, and that moving the LEVEL/SENSITIVITY control to the clockwise and counterclockwise extremes of its travel causes the trace to disappear.

# B. SWEEP

**Equipment Required:** (Numbers correspond to those listed in Table 5-3, Test Equipment.)

1. 5223 Digitizing Oscilloscope
2. Dual Trace Amplifier
5. Time-Mark Generator
6. Power Module Mainframe (for item 5)
8. Coaxial Cables (18-inch and 42-inch)
9. Terminator (50 Ω)
12. Patch Cord

Shaded lines identify Performance Requirement CHECK.

## B1. SWEEP PRELIMINARY SETUP

a. Perform the Adjustment and Performance Check Power-Up Sequence, which appears at the beginning of Part II, Adjustment and Performance Check.

b. Refer to Section 6, Instrument Options, and to the Change Information section at the back of this manual for any changes which may affect this procedure.

c. See the TEST POINT AND ADJUSTMENT LOCATIONS pages in Section 8, Diagrams and Circuit Board Illustrations.

d. Set the 5B25N controls as follows:

TIME/DIV ..... 0.5 ms
TRIGGERING
- SLOPE ..... +
- LEVEL/SENSITIVITY ..... Centered
- COUPLING ..... AC
- MODE ..... AUTO
- SOURCE ..... LEFT

DISPLAY ..... In (CHOP)
POSITION ..... Centered
X10 SWP MAG ..... Off (button out)
PRETRIGGER ..... 0%

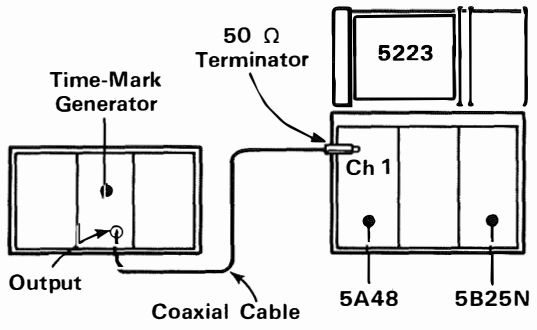
## B2. EXAMINE/ADJUST LOW-FREQUENCY TIMING

**NOTE**

*First perform step B1, then proceed.*

**B2. SETUP CONDITIONS**

5B25N Controls:
Make no changes to the control settings.




Test Equipment Controls:
5A48 Amplifier
- Ch 1 Volts/Div ..... 1 V
- Display ..... On
- Trigger ..... Ch 1

Time-Mark Generator
- Markers ..... 0.5 ms intervals

2813-511

a. Verify that the sweep is triggered. If necessary, adjust the LEVEL/SENSITIVITY control to trigger the sweep.

b. Adjust the POSITION control so that the sixth marker is at the center vertical graticule line.

c. **EXAMINE**—the display of time marks for 3% or less (0.24 division or less) deviation from graticule lines over the center eight divisions.

d. **ADJUST**—LF Tim (R320) for one marker per division over the center eight divisions.

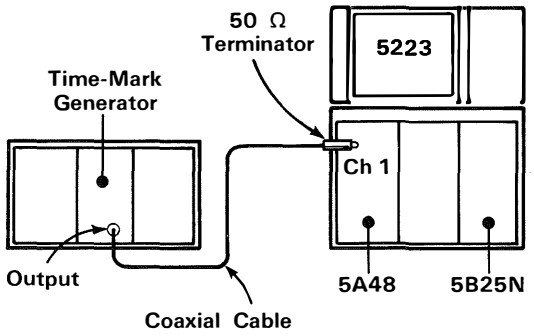
## B3. CHECK SWEEP LENGTH

**NOTE**

*If the preceding step was not performed, first perform step B1, then proceed*

**B3. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 1 ms




Test Equipment Controls:
5A48 Amplifier
Ch 1 Volts/Div ..... 1 V
Display ..... On
Trigger ..... Ch 1

Time-Mark Generator
Markers ..... 0.5 ms intervals

2813-512

a. Use the POSITION control to set the first marker to the left-most vertical graticule line.

b. **CHECK**—that the sweep is 10.5 divisions long by using the POSITION control to slowly move the display to the left. At least one 0.5 ms marker past the one at the end of the graticule should come on the right-hand side of the screen for the sweep to be 10.5 divisions long.

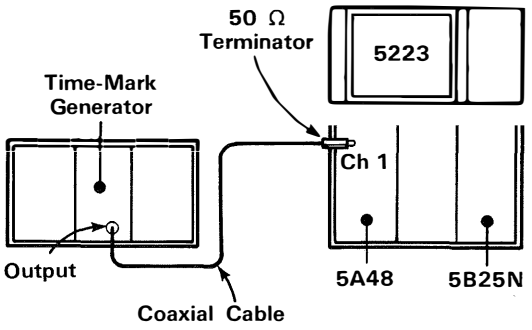
## B4. CHECK POSITION RANGE

**NOTE**

*If the preceding step was not performed, first perform step B1, then proceed.*

**B4. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 1 ms




Test Equipment Controls:
5A48 Amplifier
Ch 1 Volts/Div ..... 1 V
Display ..... On
Trigger ..... Ch 1

Time-Mark Generator
Markers ..... 0.5 ms intervals

2813-513

a. Use the POSITION control to set the first marker to the left-most vertical graticule line.

b. Move the display to the left so that you can see the 22nd marker, which is the first one past the 10-division vertical graticule line (it marks the 10.5 division point of the sweep).

c. **CHECK**—that the 10.5-division marker will move to the left of the center vertical graticule line when the POSITION control is set to its counterclockwise extreme.

d. **CHECK**—that the start of the sweep will move to the right of the center vertical graticule line by moving the POSITION control to its clockwise extreme.



@

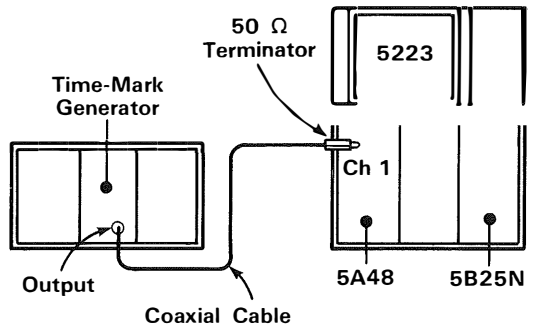
## B5. CHECK VARIABLE TIME/DIV TIMING

**NOTE**

*If the preceding step was not performed, first perform step B1, then proceed.*

**B5. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 0.2 ms




Test Equipment Controls:
5A48 Amplifier
Ch 1 Volts/Div ..... 1 V
Display ..... On
Trigger ..... Ch 1

Time-Mark Generator
Markers ..... 0.2 ms intervals

2813-514

a. Use the POSITION control to set the first marker to the left-most vertical graticule line.

b. Turn the Variable TIME/DIV control fully counterclockwise.

c. **CHECK**—that there is 2 divisions, or less, between adjacent markers.

d. Set Variable TIME/DIV to the CALibrated position.

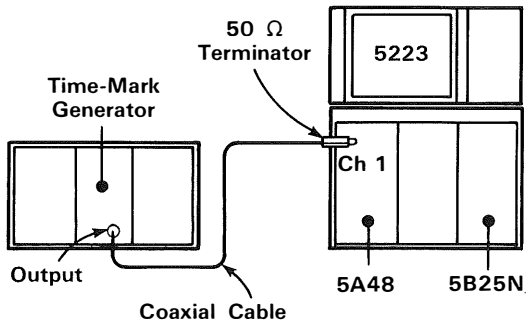
## B6. EXAMINE/ADJUST HIGH-FREQUENCY TIMING

**NOTE**

*If the preceding step was not performed, first perform step B1, then proceed.*

**B6. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 5 μs




Test Equipment Controls:
5A48 Amplifier
Ch 1 Volts/Div ..... 1
Display ..... On
Trigger ..... Ch 1

Time-Mark Generator
Markers ..... 5 μs intervals

2813-515

a. Use the POSITION control to align the second marker with the second vertical graticule line.

b. **EXAMINE**—display for one marker per division ±3% (±0.24 division) over the center eight divisions.

c. **ADJUST**—HF Timing (C228) for one marker per division over the center eight divisions.

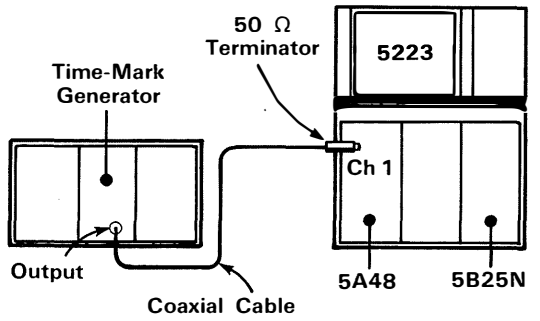
## B7. CHECK SWEEP TIMING

**NOTE**

*If the preceding step was not performed, first perform step B1, the proceed.*

**B7. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 0.2 μs




Test Equipment Controls:
5A48 Amplifier
Ch 1 Volts/Div ..... 1
Display ..... On
Trigger ..... Ch 1

Time-Mark Generator
Markers ..... 0.2 μs intervals

2813 516

**NOTE**

*Tolerances given in Table 5-6 are for an ambient temperature range of +15° to +35° C. If the temperature is outside this range, refer to section 1 for applicable tolerances.*

a. Set the POSITION control to midrange and TRIGGERING MODE to NORM.

b. **CHECK**—using the TIME/DIV and time-mark generator settings from Table 5-6, check sweep accuracy for one time mark/division over the center eight divisions within the tolerance given in Table 5-6. Set the POSITION and TRIGGERING LEVEL/SENSITIVITY controls as necessary for a stable display aligned with the vertical graticule lines.

**NOTE**

*If the time-mark generator used does not have 1-2-5 sequence markers, apply 1 unit markers in place of 2 unit markers and check for 2 markers/division, over the center eight divisions of display, to the tolerances given in Table 5-6.*

**TABLE 5-6**
**Sweep Timing**

| 5B25N TIME/DIV | Time Markers | Tolerance +15° to +35° C |
|---|---|---|
| .2 μs | .2 μs | Within 0.24 div |
| .5 μs | .5 μs | Within 0.24 div |
| 1 μs | 1 μs | Within 0.24 div |
| 2 μs | 2 μs | Within 0.24 div |
| 5 μs | 5 μs | Within 0.24 div |
| 10 μs | 10 μs | Within 0.24 div |
| 20 μs | 20 μs | Within 0.24 div |
| 50 μs | 50 μs | Within 0.24 div |
| .1 ms | .1 ms | Within 0.24 div |
| .2 ms | .2 ms | Within 0.24 div |
| .5 ms | .5 ms | Within 0.24 div |
| 1 ms | 1 ms | Within 0.24 div |
| 2 ms | 2 ms | Within 0.24 div |
| 5 ms | 5 ms | Within 0.24 div |
| 10 ms | 10 ms | Within 0.24 div |
| 20 ms | 20 ms | Within 0.24 div |
| 50 ms | 50 ms | Within 0.24 div |
| .1 s | .1 s | Within 0.24 div |
| .2 s | .2 s | Within 0.24 div |
| .5 s | .5 s | Within 0.24 div |
| 1 s | 1 s | Within 0.24 div |
| 2 s | 2 s | Within 0.32 div |
| 5 s | 5 s | Within 0.32 div |

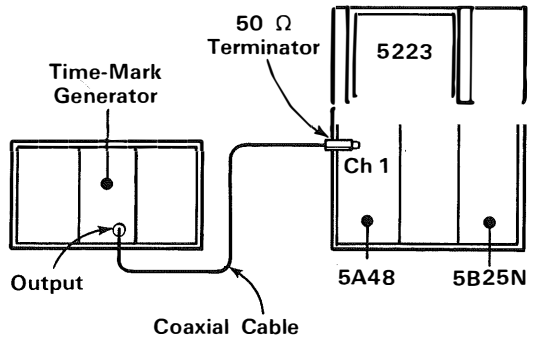
## B8. CHECK SINGLE SWEEP

**NOTE**

*If the preceding step was not performed, first perform step B1, then proceed.*

**B8. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 1 ms
- TRIGGERING
  - LEVEL/SENSITIVITY ..... To provide triggered display.




Test Equipment Controls:
- 5A48 Amplifier
  - Ch 1 Volts/Div ..... 1
  - Display ..... On
  - Trigger ..... Ch 1
- Time-Mark Generator
  - Markers ..... 1 ms

2813-518

a. Push the 5A48 Ch 1 Gnd button.

b. Press the 5B25N SINGLE SWEEP RESET button.

c. **CHECK**—that the SINGLE SWEEP READY indicator is lighted.

d. **CHECK**—that, when the 5A48 Ch 1 Gnd button is released, one sweep occurs and the SINGLE SWEEP READY indicator goes out.

e. Press the AUTO TRIGGERING MODE button on the 5B25N.

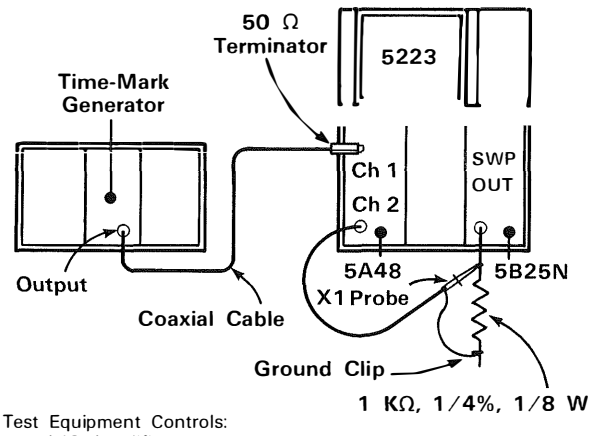
## B9. CHECK SWEEP OUT VOLTAGE

**NOTE**

*If the preceding step was not performed, first perform step B1, then proceed.*

**B9. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 1 ms
- TRIGGERING
  - SLOPE ..... +
  - COUPLING ..... AC
  - MODE ..... AUTO
  - SOURCE ..... LEFT




Test Equipment Controls:
- 5A48 Amplifier
  - Mode ..... ADD
  - Trigger ..... Ch 1
  - Input Coupling
    - Ch 1 ..... DC
    - Ch 2 ..... DC
  - Volts Div
    - Ch 1 ..... 2
    - Ch 2 ..... 0.1
- Time-Mark Generator
  - Markers ..... 1 ms
- 5223 Digitizing Oscilloscope
  - Left Memory Display ..... Pressed in
  - Intensity
    - Real Time ..... Off (fully counterclockwise)
    - Memory ..... For good display

2813-519

a. Adjust the LEVEL/SENSITIVITY control for a triggered sweep.

b. Use the 5223 Vert and Horiz Posn controls to align the second time mark with a vertical graticule line. See Figure 5-6.

c. **CHECK**—that the 7th time mark aligns with the 7th horizontal graticule line, ±6% (0.42 division). Figure 5-6 shows the desired display.

d. Release 5223 Left Memory Display button and set real-time Intensity for a moderate-brightness display.

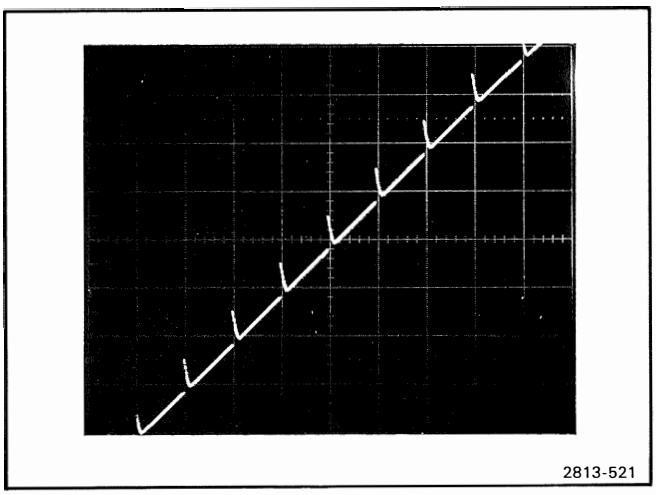



**Figure 5-6. Display of Sweep Out versus 1 ms time marks.**

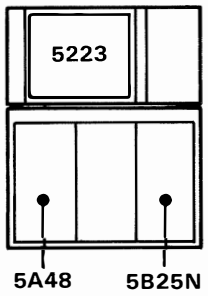
## B10. CHECK ALTERNATE AND CHOP

**NOTE**

*If the preceding step was not performed, first perform step B1, then proceed.*

**B10. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 1 ms
- TRIGGERING
  - MODE ..... AUTO
- DISPLAY ..... ALTERNATE (button out)




Test Equipment Controls:
- 5A48 Amplifier
  - Display ..... On
  - Mode
    - Ch 1 ..... pressed
    - Ch 2 ..... pressed

2813-520

a. Use the 5A48 Position controls to move the two traces to convenient locations.

b. **CHECK**—that the two traces "flicker," which shows that they are alternating.

c. **CHECK**—that, when the 5B25N DISPLAY button is pressed in, the two traces are steady. This shows that the traces are being chopped.

d. Pull the 5A48 out (part way) to temporarily disconnect it.

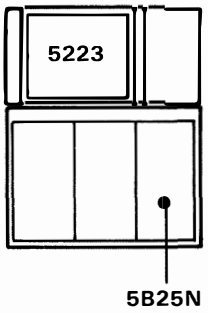
## B11. CHECK EXTERNAL SINGLE-SWEEP RESET

**NOTE**

*If the preceding step was not performed, first perform step B1, then proceed.*

**B11. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 20 ms
- TRIGGERING
  - SOURCE ..... LINE




Test Equipment Controls:
- 5223 Digitizing Oscilloscope
  - Intensity ..... Set for visible display with 5B25N TRIGGERING MODE set to AUTO, then press SINGLE SWEEP button.

2813-538

a. Use the patch cord to short the lower two camera-power terminals. They are located on the left side of the crt bezel.

b. **CHECK**—that a single sweep occurs each time you short the lower two camera-power terminals.

c. Set 5B25N TRIGGERING MODE to AUTO.

# C. X10 SWEEP MAGNIFIER

**Equipment Required:** (Numbers correspond to those listed in Table 5-3, Test Equipment.)

1. 5223 Digitizing Oscilloscope
2. Dual-Trace Amplifier
5. Time-Mark Generator
6. Power Module Mainframe (for item 5)
8. Coaxial Cable (18-inch)
9. Terminator (50 Ω)

Shaded lines identify Performance Requirement CHECK.

## C1. X10 SWEEP MAGNIFIER PRELIMINARY SETUP

a. Perform the Adjustment and Performance Check Power-Up sequence, which appears at the beginning of Part II, Adjustment and Performance Check.

b. Refer to Section 6, Instrument Options, and the Change Information section at the back of this manual for any changes which may affect this procedure.

c. See the TEST POINT AND ADJUSTMENT LOCATIONS pages in Section 8, Diagrams and Circuit Board Illustrations.

d. Set the 5B25N controls as follows:

TIME/DIV ..... 1 ms
TRIGGERING
  SLOPE ..... +
  LEVEL/SENSITIVITY ..... Centered
  COUPLING ..... AC
  MODE ..... AUTO
  SOURCE ..... LEFT
DISPLAY ..... In (CHOP)
POSITION ..... Centered
X10 SWP MAG ..... Out (X1)
PRETRIGGER ..... 0%

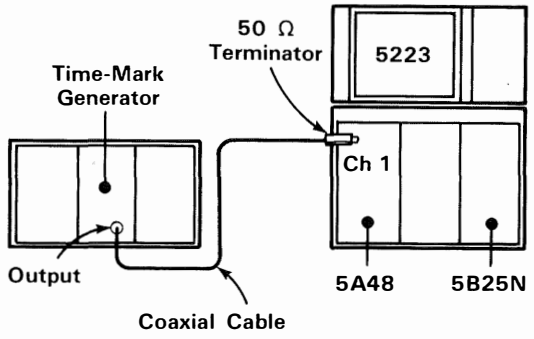
## C2. EXAMINE/ADJUST MAG GAIN

**NOTE**

*First perform step C1, then proceed.*

**C2. SETUP CONDITIONS**

5B25N Controls:
Make no changes to the control settings.




Test Equipment Controls:
5A48 Amplifier
  Ch 1 Volts/Div ..... 1
  Display ..... On
  Trigger ..... Ch 1
  Mode ..... Ch 1
Time-Mark Generator
  Markers ..... 0.1 ms

2813-522

a. Observe display—verify that sweep is triggered. If necessary, adjust the TRIGGERING LEVEL/SENSITIVITY control.

b. Press the X10 SWP MAG button.

c. **CHECK**—that X10 SWP MAG button is lighted.

d. **EXAMINE**—display for one marker per major graticule division, ±4% (±0.32 division over the center eight divisions).

e. **ADJUST**—Mag Gain (R323) for one marker per division over the center eight divisions.

f. Release the X10 SWP MAG button.

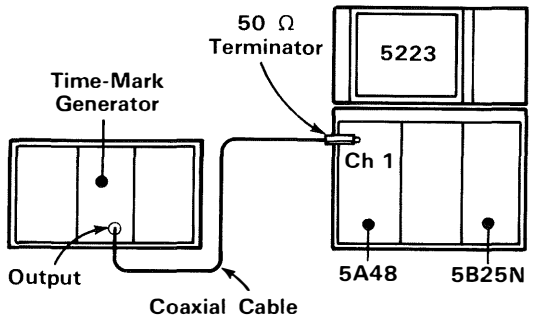
## C3. CHECK TIMING & LINEARITY OF MAGNIFIED SWEEP

**NOTE**

*If the preceding step was not performed, first perform step C1, then proceed.*

**C3. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 0.2 μs




Test Equipment Controls:
5A48 Amplifier
Ch 1 Volts/Div ..... 0.2
Display ..... On
Trigger ..... Ch 1

Time-Mark Generator
Markers ..... 20 ns

2813-523

a. Observe display to verify if sweep is triggered. If necessary, adjust the TRIGGERING LEVEL/SENSITIVITY control.

b. Press the X10 SWP MAG button.

c. **CHECK**—that the display shows one cycle per division ±4% (0.32 division over the center eight divisions) over the full sweep, except for the first 200 ns (the first 10 divisions at 20 ns/div) and anything past 105 divisions.

d. **CHECK**—timing and linearity of the magnified sweep at 0.5 μs and 1 μs over the full sweep, as shown in Table 5-7

e. Release the X10 SWP MAG button.

**TABLE 5-7**
**Magnified Sweep Timing and Linearity**

| 5B25N TIME/DIV | Time Marks | Allowable Error Over Center 8 Divisions | Remarks |
|---|---|---|---|
| .5 μs | 50 ns | ±0.32 div (4%) | First 200 ns is 4 div. |
| 1 μs | .1 μs | ±0.32 div (4%) | First 200 ns is 2 div. |

# D. EXTERNAL HORIZONTAL

**Equipment Required:** (Numbers correspond to those listed in Table 5-3, Test Equipment).

1. 5223 Digitizing Oscilloscope
2. Dual-Trace Amplifier
3. Calibration Generator
6. Power Module Mainframe (for item 3)
8. Coaxial Cable (18-inch)
9. Terminator (50 Ω)
13. Alignment Tool

Shaded lines identify Performance Requirement CHECK.

## D1. EXTERNAL HORIZONTAL PRELIMINARY SETUP

a. Perform the Adjustment and Performance Check Power-Up Sequence, which appears at the beginning of Part II, Adjustment and Performance Check.

b. Refer to Section 6, Instrument Options, and to the Change Information section at the back of this manual for any changes which may affect this procedure.

c. See the **TEST POINT AND ADJUSTMENT LOCATIONS** pages in Section 8, Diagrams and Circuit Board Illustrations.

d. Set the 5B25N controls as follows:

TIME/DIV ..... 1 ms
TRIGGERING
  SLOPE ..... +
  LEVEL/SENSITIVITY ..... Fully clockwise
  COUPLING ..... AC
  MODE ..... AUTO
  SOURCE ..... LEFT
DISPLAY ..... In (CHOP)
POSITION ..... Centered
X10 SWP MAG ..... Out (X1)
PRETRIGGER ..... 0%

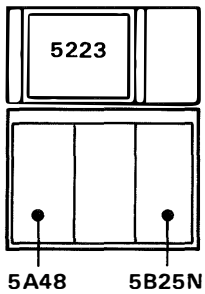
## D2. CHECK EXTERNAL HORIZONTAL BALANCE

**NOTE**

*First perform step D1, then proceed.*

**D2. SETUP CONDITIONS**

5B25N Controls:
Make no changes to the control settings.




Test Equipment Controls:
5A48 Amplifier
Display ..... On

2813-524

a. Use the 5B25N's POSITION control to set the left end of the trace to the zero graticule line.

b. Set the TIME/DIV control to AMPL position. (Keep the 5223 Intensity control at a moderate-to-low setting to avoid burning the crt.)

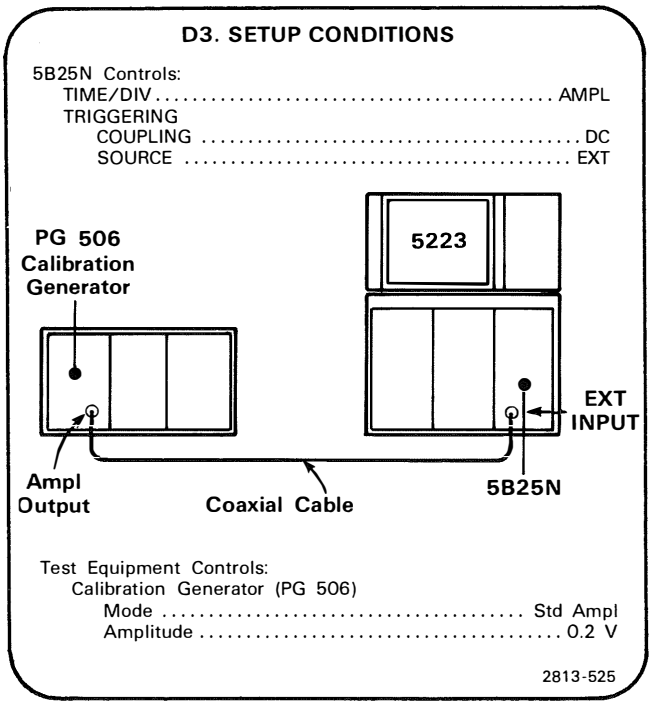
c. Press the TRIGGERING EXT SOURCE button.

d. **CHECK**—that the beam is within four horizontal divisions of graticule center.

## D3. EXAMINE/ADJUST EXTERNAL HORIZONTAL GAIN

**NOTE**

*If the preceding step was not performed, first perform step D1, then proceed.*




a. Use 5B25N POSITION control to set the left dot to a vertical graticule line.

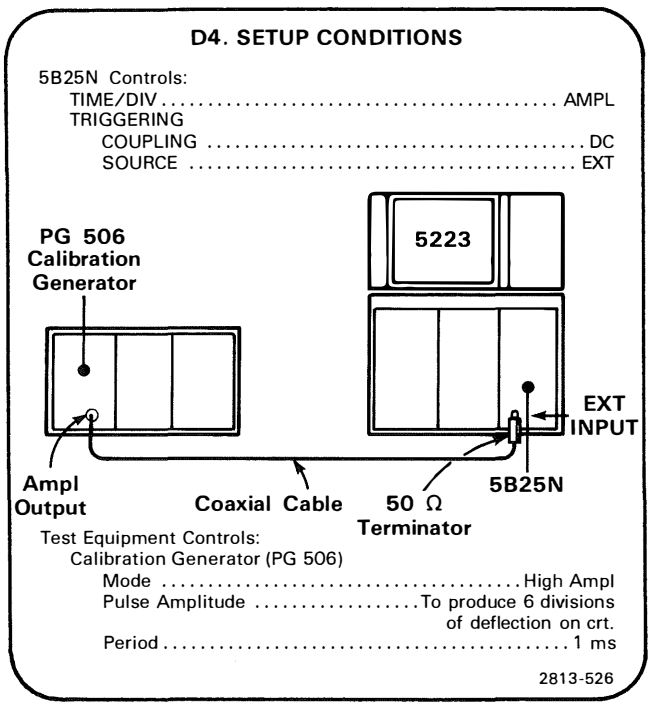
b. **EXAMINE**—that the dots are four horizontal divisions apart ±3% (±0.12 division).

c. **ADJUST**—Ext Gain (R298) to position the dots four horizontal divisions apart.

## D4. EXAMINE/ADJUST EXTERNAL HORIZONTAL COMPENSATION

**NOTE**

*If the preceding step was not performed, first perform step D1, then proceed.*




a. Verify that the horizontal deflection between the two dots is six divisions. If necessary, adjust the Pulse Amplitude of the Calibration Generator.

b. **EXAMINE**—that "tail" on right-hand dot is 0.3 division or less (5% of 6 divisions deflection).

c. **ADJUST**—Ext Comp (C17) for no "tail" on right-hand dot.



@

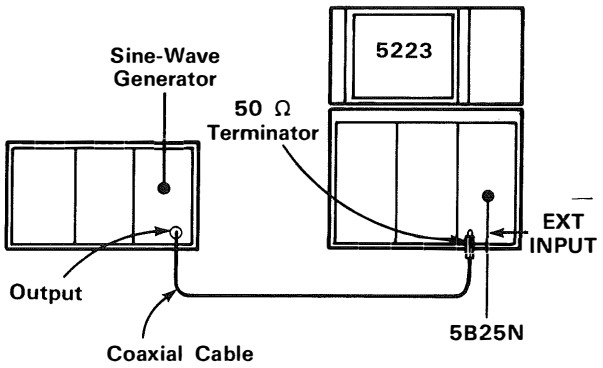
## D5. CHECK BANDWIDTH OF EXTERNAL HORIZONTAL CHANNEL

**NOTE**

*First perform step D4, then proceed.*

**D5. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... AMPL
- TRIGGERING
  - COUPLING ..... DC
  - SOURCE ..... EXT




Test Equipment Controls:
- Sine-Wave Generator
  - Frequency ..... 50 kHz
  - Output Amplitude ..... To cause a 6-division horizontal display.

2813-537

a. Use the 5B25N POSITION control to align the horizontal display with vertical graticule lines that are 6 divisions apart.

b. Set the frequency of the Sine-Wave Generator to 2.0 MHz.

c. **CHECK**—that the horizontal display is at least 4.2 divisions long.

# E. DIGITIZER-RELATED FUNCTIONS

**Equipment Required:** (Numbers correspond to those listed in Table 5-3, Test Equipment.)

1. 5223 Digitizing Oscilloscope
2. Dual-Trace Amplifier
3. Calibration Generator
4. Sine-Wave Generator
5. Time-Mark Generator
6. Power Module Mainframe (for items 3, 4, 5)
8. Coaxial Cables (18-inch and 42-inch)
9. Terminator (50 Ω)
11. Connector (bnc 'T')
12. Patch Cord
14. Alignment Tool

Shaded lines identify Performance Requirement CHECK.

## E1. DIGITIZER-RELATED FUNCTIONS PRELIMINARY SETUP

a. Perform the Adjustment and Performance Check Power-Up Sequence, which appears at the beginning of Part II, Adjustment and Performance Check.

b. Refer to Section 6, Instrument Options, and to the Change Information section at the back of this manual for any changes which may affect this procedure.

c. See the TEST POINT AND ADJUSTMENT LOCATIONS pages in Section 8, Diagrams and Circuit Board Illustrations.

d. Set the 5B25N controls as follows:

TIME/DIV ..... 0.5 ms
TRIGGERING
  SLOPE ..... +
  LEVEL/SENSITIVITY ..... Centered
  COUPLING ..... AC
  MODE ..... AUTO
  SOURCE ..... LEFT
DISPLAY ..... In (CHOP)
POSITION ..... Centered
X10 SWP MAG ..... Off (button out)
PRETRIGGER ..... 0%

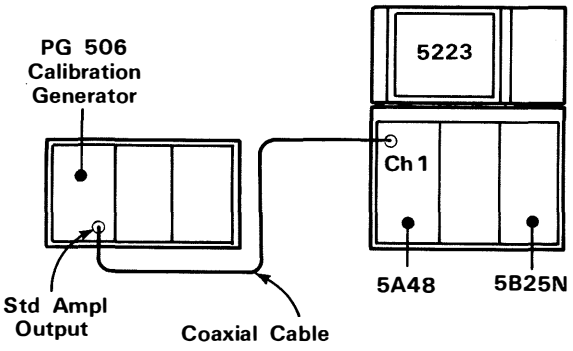
## E2. EXAMINE/ADJUST VCO FAST

**NOTE**

*First perform step E1, then proceed.*

### E2. SETUP CONDITIONS

5B25N Controls:
Make no changes to the control settings.




Test Equipment Controls:
5A48 Amplifier
  Mode ..... Ch 1
  Trigger ..... Ch 1
  Input Coupling ..... DC
  Ch 1 Volts/Div ..... 1
  Display ..... On

5223 Digitizing Oscilloscope
  Memory Contents
    Left Vert Plug-In Display ..... Pressed in
    Vert Exp ..... X1
    Horiz Exp ..... X1

Calibration Generator (PG 506)
  Amplitude ..... 2 V
  Output Selector ..... Std Ampl

2813-527



@

a. Verify that the sweep is triggered. If necessary, adjust the LEVEL/SENSITIVITY control to trigger the sweep.

b. Adjust the 5223 Intensity and Mem Inten controls for good displays.

c. Move the 5B25N Variable TIME/DIV control just out of its detent.

d. Adjust the 5223 Memory Vert and Horiz Posn controls to bring the memory display to the same starting point as the real-time display.

e. Use the 5B25N POSITION control to set the starting points of the traces to the left-most graticule line.

f. **EXAMINE**—the two waveforms, to see if they match within ±5% (±0.45 division at the ninth graticule line).

g. **ADJUST**—VCO Fast (R17) so that the memory waveform matches the real-time waveform.

h. **INTERACTION**—adjusting VCO Fast causes the VCO Slow (R19) setting to change. Perform step E3.

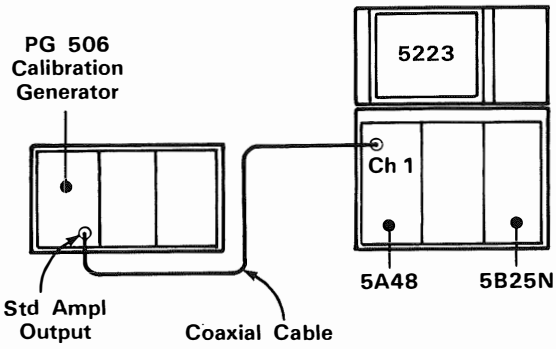
## E3. EXAMINE/ADJUST VCO SLOW

### NOTE

*If the preceding step was not performed, first perform step E1, then proceed.*

**E3. SETUP CONDITIONS**

5B25N Controls:
Make no changes to the setup conditions.




Test Equipment Controls:

5A48 Amplifier
- Mode ..... Ch 1
- Trigger ..... Ch 1
- Input Coupling ..... DC
- Ch 1 Volts/Div ..... 1
- Display ..... On

5223 Digitizing Oscilloscope
Memory Contents
- Left Vert Plug-In Display ..... Pressed in
- Vert Exp ..... X1
- Horiz Exp ..... X1

Calibration Generator (PG 506)
- Amplitude ..... 2 V
- Output Selector ..... Std Ampl

2813-528

a. Turn the 5B25N Variable TIME/DIV control to the counterclockwise extreme of its rotation.

b. Verify that the sweep is triggered. If necessary, adjust the LEVEL/SENSITIVITY control to trigger the sweep.

c. Adjust the 5223 Memory Vert and Horiz Posn controls to bring the memory display to the same starting point as the real-time display.

d. Use the 5B25N POSITION control to set the starting points of the traces to the left-most graticule line.

e. **EXAMINE**—the two waveforms to see if they match within ±5% (±0.45 division at the ninth graticule line).

f. **ADJUST**—VCO Slow (R19) so that the memory waveform matches the real-time waveform.

g. **INTERACTION**—adjusting VCO Slow causes the VCO Fast (R17) setting to change. Repeat step E2.

h. Return the Variable TIME/DIV control to the calibrated position (in the detent).

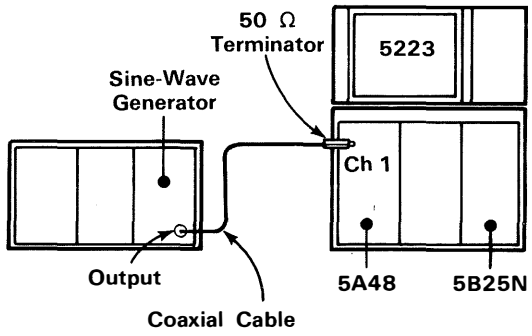
## E4. EXAMINE/ADJUST SAMPLE ZERO

**NOTE**

*If the preceding step was not performed, first perform step E1, then proceed.*

**E4. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 5 μs




Test Equipment Controls:
5A48 Amplifier
Mode ..... Ch 1
Trigger ..... Ch 1
Input Coupling ..... DC
Ch 1 Volts/Div ..... 1
Display ..... On

5223 Digitizing Oscilloscope
Memory Contents
Left Vert Plug-In Display ..... Pressed in
Vert Exp ..... X1
Horiz Exp ..... X1

Sine-Wave Generator
Frequency ..... 50 kHz
Amplitude ..... To cause a 3-division display

2813-529

a. Verify that the sweep is triggered. If necessary, adjust the LEVEL/SENSITIVITY control.

b. **EXAMINE**—the start of the memory display. It should look just like the real-time display, with no horizontal bar before the sine wave.

c. **ADJUST**—Sample Zero (R133) to its fully clockwise extreme, and observe that a horizontal bar appears before the sweep. Then, slowly turn R133 counterclockwise until the bar just disappears.

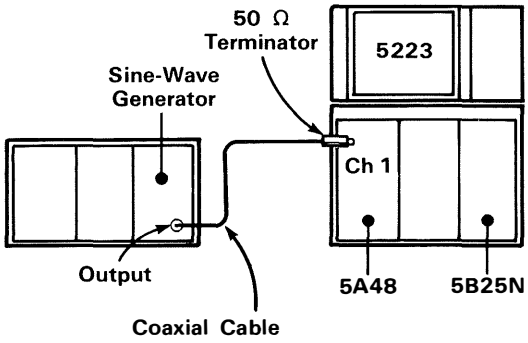
## E5. EXAMINE/ADJUST SAMPLE FULL-SCALE

**NOTE**

*If the preceding step was not performed, first perform step E1, then proceed.*

**E5. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 10 μs




Test Equipment Controls:
5A48 Amplifier
Mode ..... Ch 1
Trigger ..... Ch 1
Input Coupling ..... DC
Ch 1 Volt/Div ..... 1
Display ..... On

5223 Digitizing Oscilloscope
Memory Contents
Left Vert Plug-In Display ..... Pressed in
Vert Exp ..... X1
Horiz Exp ..... X1

Sine-Wave Generator
Frequency ..... 50 kHz
Amplitude ..... To cause a 3-division display.

2813-530

a. Verify that the sweep is triggered. If necessary, adjust the LEVEL/SENSITIVITY control.

b. Use the 5223 Vert and Horiz Posn controls to superimpose the memory display on the real-time display.

c. **EXAMINE**—the two displays to see if they match horizontally, ±4% (±0.32 division), over the center eight divisions.

d. **ADJUST**—Sample FS (R115) so that the two waveforms match horizontally.



@

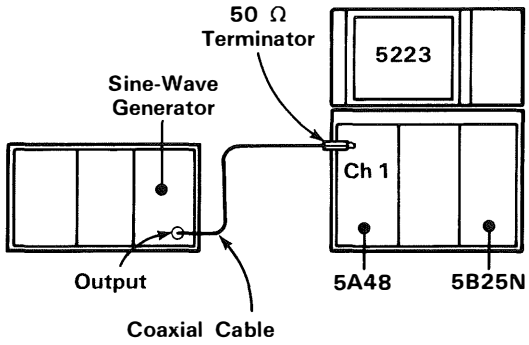
## E6. EXAMINE/ADJUST HIGH RATE COMPENSATION

**NOTE**

*If the preceding step was not performed, first perform step E1, then proceed.*

**E6. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 0.2 μs




Test Equipment Controrls:
5A48 Amplifier
Mode ..... Ch 1
Trigger ..... Ch 1
Input Coupling ..... DC
Ch 1 Volts/Div ..... 0.5
Display ..... On

5223 Digitizing Oscilloscope
Memory Contents
Left Vert Plug-In Display ..... Pressed in
Vert Exp ..... X1
Horiz Exp ..... X1

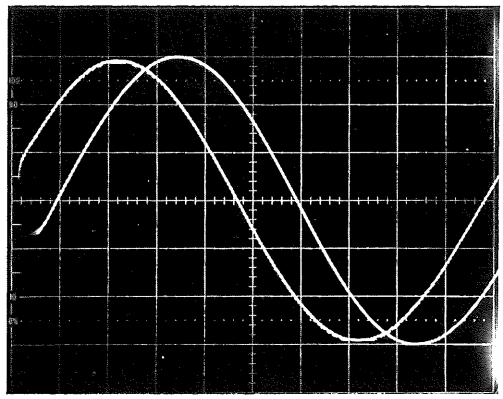
Sine-Wave Generator
Frequency ..... 500 kHz
Amplitude ..... To cause a 6-division display.

2813-531

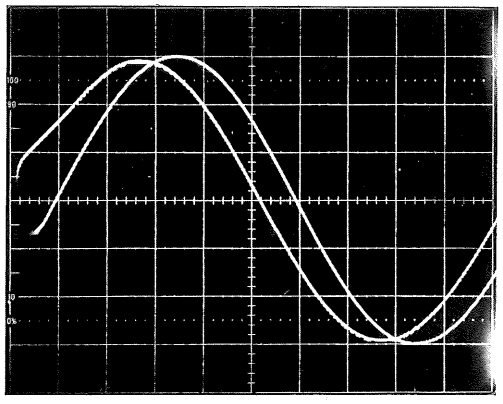
a. Adjust the LEVEL/SENSITIVITY control so that the sweep starts at the mid-point of the waveform.

b. **EXAMINE**—The positive-going slope of first half-cycle of the displayed waveform. The slope should be the same as the slope of the real-time waveform.

c. **ADJUST**—High Rate Comp (C130) so that the positive-going slope of the first half cycle of the memory display is the same as the slope of the real-time waveform. Figure 5-7 shows displays resulting from correct and incorrect adjustment of C130, High Rate Comp.



**A. High Rate Comp, C130, correctly adjusted.**



**B. High Rate Comp, C130, incorrectly adjusted.**

2813-532

**Figure 5-7. How the setting of the High Rate Comp adjustment, C130, affects the initial slope.**

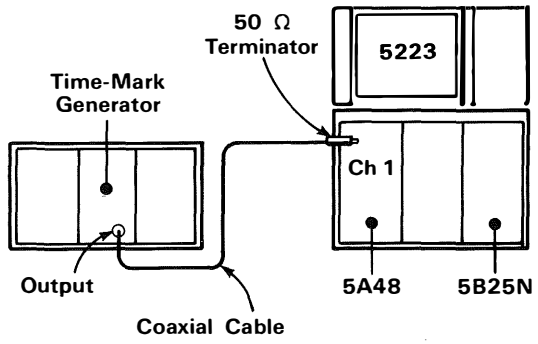
## E7. CHECK POSSIBLE UNDERSAMPLING INDICATOR

**NOTE**

*If the preceding step was not performed, first perform step E1, then proceed.*

**E7. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 0.1 ms




Test Equipment Controls:
5A48 Amplifier
Mode ..... Ch 1
Trigger ..... Ch 1
Input Coupling ..... DC
Ch 1 Volts/Div ..... 1
Display ..... On

Time-Mark Generator
Markers ..... 0.1 ms

2813-533

a. Verify that the sweep is triggered. If necessary adjust the LEVEL/SENSITIVITY control.

b. **CHECK**—that the POSSIBLE UNDERSAMPLING indicator is not lighted.

c. Change the Time-Mark Generator to produce 10 μs markers.

d. **CHECK**—that the POSSIBLE UNDERSAMPLING indicator is not lighted.

e. Set the Time-Mark Generator to produce 5 μs markers.

f. **CHECK**—that the POSSIBLE UNDERSAMPLING indicator is lighted.

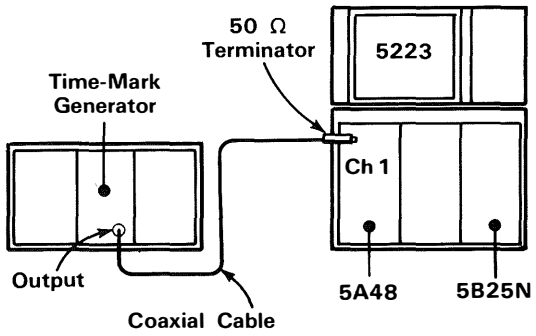
## E8. CHECK PRETRIGGER FUNCTION

**NOTE**

*If the preceding step was not performed, first perform step E1, then proceed.*

**E8. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 0.2 ms




Test Equipment Controls:
5A48 Amplifier
Mode ..... Ch 1
Trigger ..... Ch 1
Input Coupling ..... DC
Ch 1 Volts/Div ..... 1
Display ..... On

Time-Mark Generator
Markers ..... 0.2 ms

5223 Digitizing Oscilloscope
Left Vert Plug-In Display ..... Pressed in
Vert Exp ..... X1
Horiz Exp ..... X1

2813-534

a. Verify that the sweep is triggered. If necessary, adjust the LEVEL/SENSITIVITY control.

b. Release the 5A48 Display button.

c. Adjust the 5223 Mem Inten control for a low-brightness display. The low-brightness display makes it easier to see the point where the trigger event occurs, because the pretrigger time has a medium-brightness display.

d. Use the 5223 Horiz Posn control to set the right end of the memory display to the right-most line on the crt graticule.

e. Move the PRETRIGGER control out of its detent.

f. **CHECK**—that, by rotating the PRETRIGGER control from its "just-out-of-detent" position to fully counterclockwise, the intensified part of the display can be brought to the right end of the memory display.



@

g. Set the PRETRIGGER control to the 0% position—in the detent.

h. Set the TIME/DIV control to 0.5 s.

i. Set the Time Mark Generator to 0.5 s.

j. Press the NORM TRIGGERING MODE button.

k. Press the 5A48 Display button.

l. Verify that the 5B25N is triggered. If necessary, adjust the LEVEL/SENSITIVITY control.

m. **CHECK**—that the real-time and memory displays match and that the memory display updates after each real-time sweep.

n. Set the TIME/DIV control to 0.2 s.

o. **CHECK**—that the real-time and memory displays match and that the memory display updates after each real-time sweep.

p. Set the TIME/DIV control to 0.1 s.

q. **CHECK**—that the real-time and memory displays match and that the memory display updates after each real-time sweep.

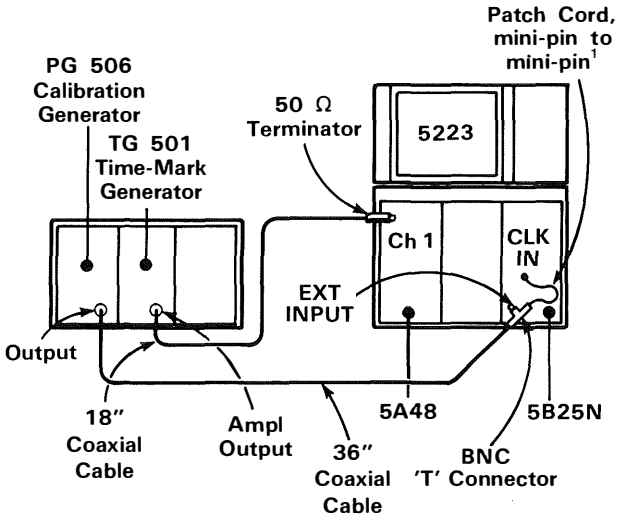
## E9. CHECK EXTERNAL SAMPLE CLOCK IN FUNCTION

**NOTE**

*If the preceding step was not performed, first perform step E1, then proceed.*

**E9. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 1 ms
SAMPLE CLK SOURCE ..... NORMAL (Pressed in)




Test Equipment Controls:
5A48 Amplifier
Mode ..... Ch 1
Trigger ..... Ch 1
Input Coupling ..... DC
Ch 1 Volts/Div ..... 1
Display ..... On

Time-Mark Generator (TG 501)
Markers ..... 1 ms

5223 Digitizing Oscilloscope
Left Vert Plug-In Display ..... Pressed in
Vert Exp ..... X1
Horiz Exp ..... X1
Intensity ..... For good display
Mem Inten ..... For good display

Calibration Generator (PG 506)
Output Selector ..... Std Ampl
Amplitude ..... 5 V

[1]**Insert one end of the patch cord into the center female pin of the bnc 'T' connector, and the other end into the 5B25N's CLK IN jack.**

2813-535

a. Verify that the sweep is triggered. If necessary, adjust the LEVEL/SENSITIVITY control.

b. Set the TIME/DIV control to 0.1 s.

c. Press the 5223 Memory Contents Roll button.

d. Pull the SAMPLE CLK SOURCE button out. (This is also the Variable TIME/DIV control.)

e. **CHECK**—for time marks moving from right to left across the crt. Figure 5-8 shows a typical display.

f. Release the 5223 Memory Contents Roll button and press in the 5B25N SAMPLE CLK SOURCE button.

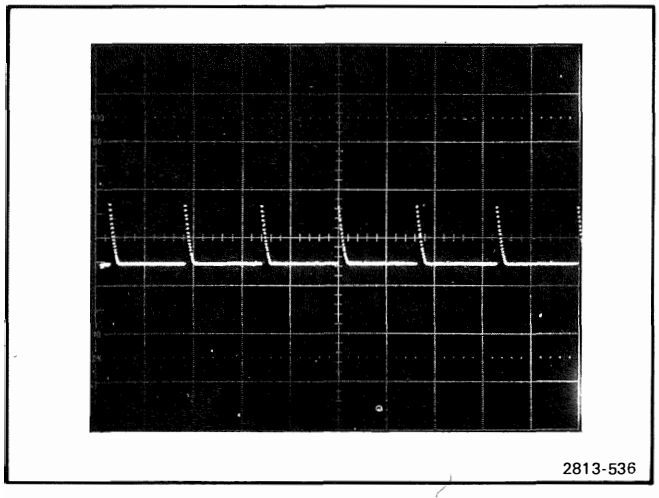



**Figure 5-8. Typical display of time marks while checking External Sample Clock In function.**

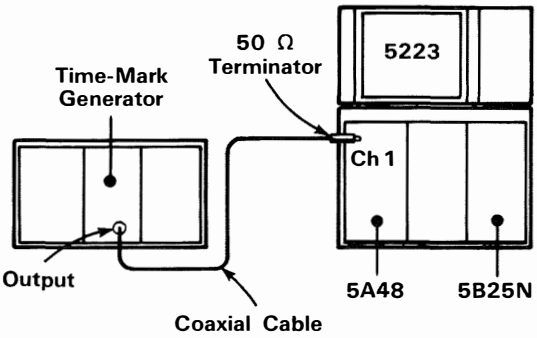
## E10. CHECK SINGLE-SWEEP LOAD STOP DISQUALIFYING

**NOTE**

*If the preceding step was not performed, first perform step E1, then proceed.*

**E10. SETUP CONDITIONS**

5B25N Controls:
- TIME/DIV ..... 0.2 s
- TRIGGERING
  - MODE ..... AUTO
- PRETRIGGER ..... 100%




Test Equipment Controls:
- 5A48 Amplifier
  - Ch 1 Volts/Div ..... 1
  - Mode ..... Ch 1
  - Trigger ..... Ch 1
  - Input Coupling ..... DC
  - Display ..... On
- 5223 Digitizing Oscilloscope
  - Left Vert Plug-In Display ..... Pressed in
  - Vert Exp ..... X1
  - Horiz Exp ..... X1
  - Intensity ..... For good display
  - Mem Inten ..... For good display
- Time-Mark Generator
  - Markers ..... 0.1 s

2813-539

a. Press the 5B25N SINGLE SWEEP RESET button.

b. Push the SINGLE SWEEP RESET button to start a sweep; then press it again before it reaches mid-trace.

c. **CHECK**—that the memory display is updated each time a new sweep starts in response to an input from the SINGLE SWEEP RESET button.

d. Set the 5B25N TRIGGERING MODE to AUTO.

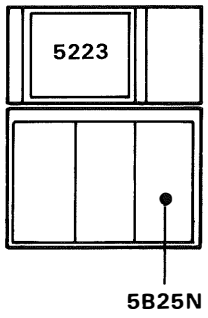
## E11. CHECK ROLL DISABLE

**NOTE**

*If the preceding step was not performed, first perform step E1, then proceed.*

**E11. SETUP CONDITIONS**

5B25N Controls:
TIME/DIV ..... 50 ms




Test Equipment Controls:
5223 Digitizing Oscilloscope
Roll ..... Pressed in

2813-540

a. **CHECK**—that the 5223 Memory Contents Roll pushbutton lights when the 5B25N TIME/DIV control is moved from 50 ms to 0.1 s.

b. Release the 5223 Memory Contents Roll and Left Vert Plug-In Display buttons.

This concludes the Adjustment and Performance Check.

# INSTRUMENT OPTIONS

No options were available for the 5B25N at the time of this printing.

Information about any subsequent options will be included in the CHANGE INFORMATION section at the back of this manual.

# REPLACEABLE ELECTRICAL PARTS

## PARTS ORDERING INFORMATION

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

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

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

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

### LIST OF ASSEMBLIES

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

### CROSS INDEX-MFR. CODE NUMBER TO MANUFACTURER

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

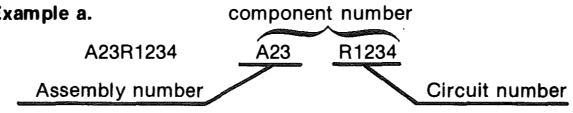
### ABBREVIATIONS

Abbreviations conform to American National Standard Y1.1.

### COMPONENT NUMBER (column one of the Electrical Parts List)

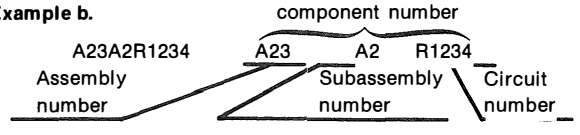
A numbering method has been used to identify assemblies, subassemblies and parts. Examples of this numbering method and typical expansions are illustrated by the following:

**Example a.**




**Read: Resistor 1234 of Assembly 23**

**Example b.**




**Read: Resistor 1234 of Subassembly 2 of Assembly 23**

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

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

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

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

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

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

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

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

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

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

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

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

Indicates actual manufacturers part number.

# CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

| Mfr. Code | Manufacturer | Address | City, State, Zip |
|---|---|---|---|
| 01121 | ALLEN-BRADLEY COMPANY | 1201 2ND STREET SOUTH | MILWAUKEE, WI 53204 |
| 01295 | TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP | P O BOX 5012, 13500 N CENTRAL EXPRESSWAY | DALLAS, TX 75222 |
| 02735 | RCA CORPORATION, SOLID STATE DIVISION | ROUTE 202 | SOMERVILLE, NY 08876 |
| 04222 | AVX CERAMICS, DIVISION OF AVX CORP. | P O BOX 867, 19TH AVE. SOUTH | MYRTLE BEACH, SC 29577 |
| 04713 | MOTOROLA, INC., SEMICONDUCTOR PROD. DIV. | 5005 E MCDOWELL RD,PO BOX 20923 | PHOENIX, AZ 85036 |
| 07263 | FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP. | 464 ELLIS STREET | MOUNTAIN VIEW, CA 94042 |
| 08806 | GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT | NELA PARK | CLEVELAND, OH 44112 |
| 09023 | CORNELL-DUBILIER ELECTRONIC DIVISION FEDERAL PACIFIC ELECTRIC CO. | 2652 DALRYMPLE ST. | SANFORD, NC 27330 |
| 12697 | CLAROSTAT MFG. CO., INC. | LOWER WASHINGTON STREET | DOVER, NH 03820 |
| 12969 | UNITRODE CORPORATION | 580 PLEASANT STREET | WATERTOWN, MA 02172 |
| 14552 | MICRO SEMICONDUCTOR CORP. | 2830 F FAIRVIEW ST. | SANTA ANA, CA 92704 |
| 16299 | CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION | 3900 ELECTRONICS DR. | RALEIGH, NC 27604 |
| 18324 | SIGNETICS CORP. | 811 E. ARQUES | SUNNYVALE, CA 94086 |
| 24546 | CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION | 550 HIGH STREET | BRADFORD, PA 16701 |
| 27014 | NATIONAL SEMICONDUCTOR CORP. | 2900 SEMICONDUCTOR DR. | SANTA CLARA, CA 95051 |
| 33096 | COLORADO CRYSTAL CORPORATION | 2303 W 8TH STREET | LOVELAND, CO 80537 |
| 50088 | MOSTEK CORP. | 1400 UPFIELD DR. | CARROLLTON, TX 75006 |
| 50434 | HEWLETT-PACKARD COMPANY | 640 PAGE MILL ROAD | PALO ALTO, CA 94304 |
| 50522 | MONSANTO CO., ELECTRONIC SPECIAL PRODUCTS | 3400 HILLVIEW AVENUE | PALO ALTO, CA 94304 |
| 53184 | XCITON CORPORATION | 5 HEMLOCK STREET | LATHAM, NY 12110 |
| 55210 | GETTIG ENG. AND MFG. COMPANY | PO BOX 85, OFF ROUTE 45 | SPRING MILLS, PA 16875 |
| 55680 | NICHICON/AMERICA/CORP. | 6435 N PROESEL AVENUE | CHICAGO, IL 60645 |
| 56289 | SPRAGUE ELECTRIC CO. | 87 MARSHALL ST. | NORTH ADAMS, MA 01247 |
| 71590 | CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC. | P O BOX 858 | FORT DODGE, IA 50501 |
| 72982 | ERIE TECHNOLOGICAL PRODUCTS, INC. | 644 W. 12TH ST. | ERIE, PA 16512 |
| 73138 | BECKMAN INSTRUMENTS, INC., HELIPOT DIV. | 2500 HARBOR BLVD. | FULLERTON, CA 92634 |
| 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., P O BOX 5825 | COMPTON, CA 90224 |
| 80009 | TEKTRONIX, INC. | P O BOX 500 | BEAVERTON, OR 97077 |
| 80031 | ELECTRA-MIDLAND CORP., MEPCO DIV. | 22 COLUMBIA ROAD | MORRISTOWN, NJ 07960 |
| 80737 | CHAPMAN CHEMICAL CO. | P O BOX 9158 | MEMPHIS, IN 38109 |
| 90201 | MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC. | 3029 E. WASHINGTON STREET P. O. BOX 372 | INDIANAPOLIS, IN 46206 |
| 91637 | DALE ELECTRONICS, INC. | P. O. BOX 609 | COLUMBUS, NE 68601 |

| Component No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|
| A1 | 670-5926-00 | | | CKT BOARD ASSY:SWEEP | 80009 | 670-5926-00 |
| A2 | 670-5927-00 | | | CKT BOARD ASSY:DIGITAL | 80009 | 670-5927-00 |
| A1 | ----- ----- | | | CKT BOARD ASSY:SWEEP | | |
| A1C7 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A1C10 | 281-0760-00 | | | CAP.,FXD,CER DI:22PF,10%,500V | 72982 | 0314021 C0G0220K |
| A1C12 | 281-0815-00 | | | CAP.,FXD,CER DI:0.027UF,20%,50V | 72982 | 8005D9AABW5R273M |
| A1C14 | 283-0068-00 | | | CAP.,FXD,CER DI:0.01UF,+100-0%,500V | 56289 | 19C241 |
| A1C16 | 281-0757-00 | | | CAP.,FXD,CER DI:10PF,20%,100V | 72982 | 8035-D-C0G-100G |
| A1C17 | 281-0207-00 | | | CAP.,VAR,PLSTC:2-18PF,100V | 80031 | 2807C00218MH02F0 |
| A1C20 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A1C28 | 290-0534-00 | | | CAP.,FXD,ELCTLT:1UF,20%,35V | 56289 | 196D105X0035HA1 |
| A1C33 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A1C62 | 281-0812-00 | | | CAP.,FXD,CER DI:1000PF,10%,100V | 72982 | 8035D9AADX7R102K |
| A1C64 | 281-0775-00 | | | CAP.,FXD,CER DI:0.1UF,20%,50V | 72982 | 8005D9AABZ5U104M |
| A1C65 | 281-0775-00 | | | CAP.,FXD,CER DI:0.1UF,20%,50V | 72982 | 8005D9AABZ5U104M |
| A1C67 | 281-0812-00 | | | CAP.,FXD,CER DI:1000PF,10%,100V | 72982 | 8035D9AADX7R102K |
| A1C73 | 281-0775-00 | | | CAP.,FXD,CER DI:0.1UF,20%,50V | 72982 | 8005D9AABZ5U104M |
| A1C74 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A1C80 | 281-0775-00 | | | CAP.,FXD,CER DI:0.1UF,20%,50V | 72982 | 8005D9AABZ5U104M |
| A1C84 | 281-0759-00 | | | CAP.,FXD,CER DI:22PF,10%,100V | 72982 | 8035D9AADC1G220K |
| A1C87 | 281-0814-00 | | | CAP.,FXD,CER DI:100PF,10%,100V | 04222 | GC70-1-A101K |
| A1C107 | 281-0775-00 | | | CAP.,FXD,CER DI:0.1UF,20%,50V | 72982 | 8005D9AABZ5U104M |
| A1C109 | 281-0775-00 | | | CAP.,FXD,CER DI:0.1UF,20%,50V | 72982 | 8005D9AABZ5U104M |
| A1C126 | 281-0775-00 | | | CAP.,FXD,CER DI:0.1UF,20%,50V | 72982 | 8005D9AABZ5U104M |
| A1C130 | 290-0264-00 | | | CAP.,FXD,ELCTLT:0.22UF,10%,35V | 56289 | 162D224X9035BC2 |
| A1C135 | 290-0536-00 | | | CAP.,FXD,ELCTLT:10UF,20%,25V | 90201 | TDC106M025FL |
| A1C136 | 283-0167-00 | | | CAP.,FXD,CER DI:0.1UF,10%,100V | 72982 | 8131N145X5R0104K |
| A1C138 | 281-0812-00 | | | CAP.,FXD,CER DI:1000PF,10%,100V | 72982 | 8035D9AADX7R102K |
| A1C161 | 281-0767-00 | | | CAP.,FXD,CER DI:330PF,20%,100V | 12969 | CGB331MEX |
| A1C174 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A1C175 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A1C189 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A1C209 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A1C219 | 281-0786-00 | | | CAP.,FXD,CER DI:150PF,10%,100V | 72982 | 8035D2AADX5P151K |
| A1C221 | 283-0144-00 | | | CAP.,FXD,CER DI:33PF,1%,500V | 72982 | 801-547P2G330G |
| A1C224<br>A1C225<br>A1C227 | 295-0192-00 | | | CAP SET,MATCHED:1EA,10.0UF/0.099UF/950PF | 80009 | 295-0192-00 |
| A1C228 | 281-0205-00 | | | CAP.,VAR,PLSTC:4-65PF,100V | 80031 | 2810C5R565QJ02F0 |
| A1C233 | 290-0536-00 | | | CAP.,FXD,ELCTLT:10UF,20%,25V | 90201 | TDC106M025FL |
| A1C245 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A1C283 | 281-0767-00 | | | CAP.,FXD,CER DI:330PF,20%,100V | 12969 | CGB331MEX |
| A1C287 | 283-0782-00 | | | CAP.,FXD,MICA D:39 PF,5%,500V | 09023 | CD15ED390J03 |
| A1C291 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A1C294 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A1C301 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A1C324 | 281-0757-00 | | | CAP.,FXD,CER DI:10PF,20%,100V | 72982 | 8035-D-C0G-100G |
| A1C341 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A1C352 | 290-0804-00 | | | CAP.,FXD,ELCTLT:10UF,+50-10%,25V | 55680 | 25ULA10V-T |
| A1C358 | 290-0804-00 | | | CAP.,FXD,ELCTLT:10UF,+50-10%,25V | 55680 | 25ULA10V-T |
| A1C360 | 290-0782-00 | | | CAP.,FXD,ELCTLT:4.7UF,+75-10%,35V | 55680 | 35ULA4R7V-T |
| A1C361 | 281-0775-00 | | | CAP.,FXD,CER DI:0.1UF,20%,50V | 72982 | 8005D9AABZ5U104M |
| A1C362 | 290-0804-00 | | | CAP.,FXD,ELCTLT:10UF,+50-10%,25V | 55680 | 25ULA10V-T |
| A1C363 | 290-0522-00 | | | CAP.,FXD,ELCTLT:1UF,20%,50V | 56289 | 196D105X0050HA1 |

| Component No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|
| A1CR22 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A1CR24 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A1CR25 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A1CR54 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A1CR55 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A1CR58 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A1CR59 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A1CR75 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A1CR82 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A1CR117 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A1CR119 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A1CR161 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A1CR219 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A1CR291 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A1CR341 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A1DS24 | 150-1036-00 | | | LAMP,LED:RED,3.0V,40MA | 01295 | TIL 209A |
| A1DS25 | 150-1036-00 | | | LAMP,LED:RED,3.0V,40MA | 01295 | TIL 209A |
| A1DS148 | 150-1064-00 | | | LT EMITTING DIO:YELLOW,585NM,40 MA MAX | 50522 | MV5374C |
| A1DS325 | 150-0100-00 | | | LAMP,INCAND:5V,0.115A,#515,WIRE LEADS | 08806 | 515 |
| A1L352 | 108-0245-00 | | | COIL,RF:3.9UH | 76493 | B6310-1 |
| A1L358 | 108-0245-00 | | | COIL,RF:3.9UH | 76493 | B6310-1 |
| A1L360 | 108-0245-00 | | | COIL,RF:3.9UH | 76493 | B6310-1 |
| A1L362 | 108-0245-00 | | | COIL,RF:3.9UH | 76493 | B6310-1 |
| A1Q20A,B | 151-1090-02 | | | TRANSISTOR:SILICON,FE,DUAL,N-CHANNEL | 80009 | 151-1090-02 |
| A1Q27 | 151-0301-00 | | | TRANSISTOR:SILICON,PNP | 27014 | 2N2907A |
| A1Q32 | 151-0301-00 | | | TRANSISTOR:SILICON,PNP | 27014 | 2N2907A |
| A1Q47 | 151-0190-00 | | | TRANSISTOR:SILICON,NPN | 07263 | S032677 |
| A1Q52 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 04713 | SPS6868K |
| A1Q95 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 04713 | SPS6868K |
| A1Q97 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 04713 | SPS6868K |
| A1Q113 | 151-0190-00 | | | TRANSISTOR:SILICON,NPN | 07263 | S032677 |
| A1Q124 | 151-0190-00 | | | TRANSISTOR:SILICON,NPN | 07263 | S032677 |
| A1Q159 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 04713 | SPS6868K |
| A1Q202 | 151-0216-00 | | | TRANSISTOR:SILICON,PNP | 04713 | SPS8803 |
| A1Q204 | 151-0126-00 | | | TRANSISTOR:SILICON,NPN | 04713 | ST1046 |
| A1Q209 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 04713 | SPS6868K |
| A1Q214 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 04713 | SPS6868K |
| A1Q218 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 04713 | SPS6868K |
| A1Q223 | 151-1025-00 | | | TRANSISTOR:SILICON,JFE,N-CHANNEL | 01295 | SFB8129 |
| A1Q229 | 151-0190-00 | | | TRANSISTOR:SILICON,NPN | 07263 | S032677 |
| A1Q241 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 04713 | SPS6868K |
| A1Q245 | 151-0190-00 | | | TRANSISTOR:SILICON,NPN | 07263 | S032677 |
| A1Q249 | 151-0190-00 | | | TRANSISTOR:SILICON,NPN | 07263 | S032677 |
| A1Q260 | 151-0190-00 | | | TRANSISTOR:SILICON,NPN | 07263 | S032677 |
| A1Q265 | 151-0221-00 | | | TRANSISTOR:SILICON,PNP | 04713 | SPS246 |
| A1Q269 | 151-0221-00 | | | TRANSISTOR:SILICON,PNP | 04713 | SPS246 |
| A1Q280 | 151-0190-00 | | | TRANSISTOR:SILICON,NPN | 07263 | S032677 |
| A1Q285 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 04713 | SPS6868K |
| A1Q295 | 151-0190-00 | | | TRANSISTOR:SILICON,NPN | 07263 | S032677 |
| A1Q308 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 04713 | SPS6868K |
| A1Q314 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 04713 | SPS6868K |
| A1Q338 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 04713 | SPS6868K |
| A1R1 | 321-0078-00 | | | RES.,FXD,FILM:63.4 OHM,1%,0.125W | 91637 | MFF1816G63R40F |
| A1R3 | 321-0078-00 | | | RES.,FXD,FILM:63.4 OHM,1%,0.125W | 91637 | MFF1816G63R40F |
| A1R5 | 315-0513-00 | | | RES.,FXD,CMPSN:51K OHM,5%,0.25W | 01121 | CB5135 |
| A1R6 | 315-0101-00 | | | RES.,FXD,CMPSN:100 OHM,5%,0.25W | 01121 | CB1015 |
| A1R7 | 315-0682-00 | | | RES.,FXD,CMPSN:6.8K OHM,5%,0.25W | 01121 | CB6825 |

| Component No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|
| A1R9 | 322-0464-00 | | | RES.,FXD,FILM:665K OHM,1%,0.25W | 75042 | CEBT0-6653F |
| A1R10 | 315-0221-00 | | | RES.,FXD,CMPSN:220 OHM,5%,0.25W | 01121 | CB2215 |
| A1R16 | 321-0435-00 | | | RES.,FXD,FILM:332K OHM,1%,0.125W | 91637 | MFF1816G33202F |
| A1R20 | 315-0330-00 | | | RES.,FXD,CMPSN:33 OHM,5%,0.25W | 01121 | CB3305 |
| A1R22 | 315-0220-00 | | | RES.,FXD,CMPSN:22 OHM,5%,0.25W | 01121 | CB2205 |
| A1R28 | 315-0180-00 | | | RES.,FXD,CMPSN:18 OHM,5%,0.25W | 01121 | CB1805 |
| A1R29 | 311-1731-00 | | | RES.,VAR,NONWIR:20 OHM,0.5W | 73138 | 91AR20-94A |
| A1R30 | 315-0330-00 | | | RES.,FXD,CMPSN:33 OHM,5%,0.25W | 01121 | CB3305 |
| A1R32 | 315-0272-00 | | | RES.,FXD,CMPSN:2.7K OHM,5%,0.25W | 01121 | CB2725 |
| A1R35 | 315-0362-00 | | | RES.,FXD,CMPSN:3.6K OHM,5%,0.25W | 01121 | CB3625 |
| A1R36 | 315-0471-00 | | | RES.,FXD,CMPSN:470 OHM,5%,0.25W | 01121 | CB4715 |
| A1R39 | 315-0510-00 | | | RES.,FXD,CMPSN:51 OHM,5%,0.25W | 01121 | CB5105 |
| A1R41 | 315-0471-00 | | | RES.,FXD,CMPSN:470 OHM,5%,0.25W | 01121 | CB4715 |
| A1R42 | 321-0297-00 | | | RES.,FXD,FILM:12.1K OHM,1%,0.125W | 91637 | MFF1816G12101F |
| A1R44 | 321-0299-00 | | | RES.,FXD,FILM:12.7K OHM,1%,0.125W | 91637 | MFF1816G12701F |
| A1R45 | 315-0472-00 | | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| A1R47 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| A1R49 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| A1R51 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| A1R53 | 315-0472-00 | | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| A1R58 | 315-0472-00 | | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| A1R59 | 315-0472-00 | | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| A1R61 | 315-0101-00 | | | RES.,FXD,CMPSN:100 OHM,5%,0.25W | 01121 | CB1015 |
| A1R63 | 321-0289-00 | | | RES.,FXD,FILM:10K OHM,1%,0.125W | 91637 | MFF1816G10001F |
| A1R64 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| A1R65 | 321-0289-00 | | | RES.,FXD,FILM:10K OHM,1%,0.125W | 91637 | MFF1816G10001F |
| A1R68 | 315-0101-00 | | | RES.,FXD,CMPSN:100 OHM,5%,0.25W | 01121 | CB1015 |
| A1R70 | 315-0101-00 | | | RES.,FXD,CMPSN:100 OHM,5%,0.25W | 01121 | CB1015 |
| A1R72 | 315-0393-00 | | | RES.,FXD,CMPSN:39K OHM,5%,0.25W | 01121 | CB3935 |
| A1R74 | 315-0393-00 | | | RES.,FXD,CMPSN:39K OHM,5%,0.25W | 01121 | CB3935 |
| A1R77 | 315-0101-00 | | | RES.,FXD,CMPSN:100 OHM,5%,0.25W | 01121 | CB1015 |
| A1R79 | 315-0393-00 | | | RES.,FXD,CMPSN:39K OHM,5%,0.25W | 01121 | CB3935 |
| A1R81 | 315-0393-00 | | | RES.,FXD,CMPSN:39K OHM,5%,0.25W | 01121 | CB3935 |
| A1R84 | 321-0134-00 | | | RES.,FXD,FILM:243 OHM,1%,0.125W | 91637 | MFF1816G243R0F |
| A1R85 | 321-0097-00 | | | RES.,FXD,FILM:100 OHM,1%,0.125W | 91637 | MFF1816G100R0F |
| A1R86 | 321-0173-00 | | | RES.,FXD,FILM:619 OHM,1%,0.125W | 91637 | MFF1816G619R0F |
| A1R87 | 315-0220-00 | | | RES.,FXD,CMPSN:22 OHM,5%,0.25W | 01121 | CB2205 |
| A1R89 | 321-0202-00 | | | RES.,FXD,FILM:1.24K OHM,1%,0.125W | 91637 | MFF1816G12400F |
| A1R90 | 321-0248-00 | | | RES.,FXD,FILM:3.74K OHM,1%,0.125W | 91637 | MFF1816G37400F |
| A1R91 | 315-0220-00 | | | RES.,FXD,CMPSN:22 OHM,5%,0.25W | 01121 | CB2205 |
| A1R95 | 315-0102-00 | | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| A1R96 | 315-0161-00 | | | RES.,FXD,CMPSN:160 OHM,5%,0.25W | 01121 | CB1615 |
| A1R97 | 315-0102-00 | | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| A1R99 | 315-0471-00 | | | RES.,FXD,CMPSN:470 OHM,5%,0.25W | 01121 | CB4715 |
| A1R101 | 315-0472-00 | | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| A1R105 | 315-0202-00 | | | RES.,FXD,CMPSN:2K OHM,5%,0.25W | 01121 | CB2025 |
| A1R113 | 315-0202-00 | | | RES.,FXD,CMPSN:2K OHM,5%,0.25W | 01121 | CB2025 |
| A1R115 | 315-0472-00 | | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| A1R122 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| A1R124 | 315-0101-00 | | | RES.,FXD,CMPSN:100 OHM,5%,0.25W | 01121 | CB1015 |
| A1R125 | 315-0104-00 | | | RES.,FXD,CMPSN:100K OHM,5%,0.25W | 01121 | CB1045 |
| A1R126 | 315-0474-00 | | | RES.,FXD,CMPSN:470K OHM,5%,0.25W | 01121 | CB4745 |
| A1R128 | 315-0472-00 | | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| A1R130 | 315-0474-00 | | | RES.,FXD,CMPSN:470K OHM,5%,0.25W | 01121 | CB4745 |
| A1R133 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| A1R135 | 315-0913-00 | | | RES.,FXD,CMPSN:91K OHM,5%,0.25W | 01121 | CB9135 |
| A1R139 | 315-0272-00 | | | RES.,FXD,CMPSN:2.7K OHM,5%,0.25W | 01121 | CB2725 |

| Component No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|
| A1R141 | 321-0222-00 | | | RES.,FXD,FILM:2K OHM,1%,0.125W | 91637 | MFF1816G20000F |
| A1R142 | 321-0244-00 | | | RES.,FXD,FILM:3.4K OHM,1%,0.125W | 91637 | MFF1816G34000F |
| A1R143 | 321-0213-00 | | | RES.,FXD,FILM:1.62K OHM,1%,0.125W | 91637 | MFF1816G16200F |
| A1R146 | 315-0221-00 | | | RES.,FXD,CMPSN:220 OHM,5%,0.25W | 01121 | CB2215 |
| A1R148 | 315-0221-00 | | | RES.,FXD,CMPSN:220 OHM,5%,0.25W | 01121 | CB2215 |
| A1R149 | 315-0102-00 | | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| A1R151 | 315-0152-00 | | | RES.,FXD,CMPSN:1.5K OHM,5%,0.25W | 01121 | CB1525 |
| A1R153 | 315-0202-00 | | | RES.,FXD,CMPSN:2K OHM,5%,0.25W | 01121 | CB2025 |
| A1R157 | 315-0202-00 | | | RES.,FXD,CMPSN:2K OHM,5%,0.25W | 01121 | CB2025 |
| A1R158 | 315-0472-00 | | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| A1R159 | 315-0622-00 | | | RES.,FXD,CMPSN:6.2K OHM,5%,0.25W | 01121 | CB6225 |
| A1R161 | 315-0152-00 | | | RES.,FXD,CMPSN:1.5K OHM,5%,0.25W | 01121 | CB1525 |
| A1R172 | 321-0243-00 | | | RES.,FXD,FILM:3.32K OHM,1%,0.125W | 91637 | MFF1816G33200F |
| A1R173 | 321-0218-00 | | | RES.,FXD,FILM:1.82K OHM,1%,0.125W | 91637 | MFF1816G18200F |
| A1R175 | 321-0289-02 | | | RES.,FXD,FILM:10K OHM,0.5%,0.125W | 91637 | MFF1816D10001D |
| A1R176 | 321-1330-02 | | | RES.,FXD,FILM:27.1K OHM,0.5%,0.125W | 24546 | NC55C2712D |
| A1R180 | 321-0816-03 | | | RES.,FXD,FILM:5K OHM,0.25%,0.125W | 91637 | MFF1816D50000C |
| A1R182 | 321-0932-03 | | | RES.,FXD,FILM:2.5K OHM,0.25%,0.125W | 91637 | MFF1816D25000C |
| A1R183 | 321-0932-03 | | | RES.,FXD,FILM:2.5K OHM,0.25%,0.125W | 91637 | MFF1816D25000C |
| A1R185 | 321-1173-03 | | | RES.,FXD,FILM:626 OHM,0.25%,0.125W | 01121 | OBD |
| A1R187 | 321-0932-03 | | | RES.,FXD,FILM:2.5K OHM,0.25%,0.125W | 91637 | MFF1816D25000C |
| A1R189 | 321-0469-04 | | | RES.,FXD,FILM:750K OHM,0.1%,0.125W | 91637 | MFF1816D75002B |
| A1R191 | 321-0222-03 | | | RES.,FXD,FILM:2K OHM,0.25%,0.125W | 91637 | MFF1816D20000C |
| A1R193 | 321-0932-03 | | | RES.,FXD,FILM:2.5K OHM,0.25%,0.125W | 91637 | MFF1816D25000C |
| A1R195 | 321-0964-07 | | | RES.,FXD,FILM:49.31K OHM,0.1%,0.125W | 91637 | MFF1816C49311B |
| A1R197 | 321-0648-02 | | | RES.,FXD,FILM:500K OHM,0.5%,0.125W | 24546 | NC55C5003D |
| A1R198 | 315-0107-00 | | | RES.,FXD,CMPSN:100M OHM,5%,0.25W | 01121 | CB1075 |
| A1R200 | 315-0101-00 | | | RES.,FXD,CMPSN:100 OHM,5%,0.25W | 01121 | CB1015 |
| A1R205 | 315-0151-00 | | | RES.,FXD,CMPSN:150 OHM,5%,0.25W | 01121 | CB1515 |
| A1R207 | 315-0512-00 | | | RES.,FXD,CMPSN:5.1K OHM,5%,0.25W | 01121 | CB5125 |
| A1R210 | 315-0102-00 | | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| A1R211 | 315-0101-00 | | | RES.,FXD,CMPSN:100 OHM,5%,0.25W | 01121 | CB1015 |
| A1R212 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| A1R215 | 315-0133-00 | | | RES.,FXD,CMPSN:13K OHM,5%,0.25W | 01121 | CB1335 |
| A1R216 | 315-0202-00 | | | RES.,FXD,CMPSN:2K OHM,5%,0.25W | 01121 | CB2025 |
| A1R219 | 315-0152-00 | | | RES.,FXD,CMPSN:1.5K OHM,5%,0.25W | 01121 | CB1525 |
| A1R221 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| A1R228 | 315-0473-00 | | | RES.,FXD,CMPSN:47K OHM,5%,0.25W | 01121 | CB4735 |
| A1R229 | 315-0113-00 | | | RES.,FXD,CMPSN:11K OHM,5%,0.25W | 01121 | CB1135 |
| A1R230 | 315-0821-00 | | | RES.,FXD,CMPSN:820 OHM,5%,0.25W | 01121 | CB8215 |
| A1R238 | 315-0102-00 | | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| A1R239 | 315-0822-00 | | | RES.,FXD,CMPSN:8.2K OHM,5%,0.25W | 01121 | CB8225 |
| A1R241 | 315-0331-00 | | | RES.,FXD,CMPSN:330 OHM,5%,0.25W | 01121 | CB3315 |
| A1R243 | 315-0101-00 | | | RES.,FXD,CMPSN:100 OHM,5%,0.25W | 01121 | CB1015 |
| A1R246 | 315-0512-00 | | | RES.,FXD,CMPSN:5.1K OHM,5%,0.25W | 01121 | CB5125 |
| A1R250 | 315-0512-00 | | | RES.,FXD,CMPSN:5.1K OHM,5%,0.25W | 01121 | CB5125 |
| A1R252 | 321-0197-00 | | | RES.,FXD,FILM:1.1K OHM,1%,0.125W | 91637 | MFF1816G11000F |
| A1R253 | 321-0293-00 | | | RES.,FXD,FILM:11K OHM,1%,0.125W | 91637 | MFF1816G11001F |
| A1R255 | 321-0289-00 | | | RES.,FXD,FILM:10K OHM,1%,0.125W | 91637 | MFF1816G10001F |
| A1R261 | 315-0392-00 | | | RES.,FXD,CMPSN:3.9K OHM,5%,0.25W | 01121 | CB3925 |
| A1R262 | 321-0193-00 | | | RES.,FXD,FILM:1K OHM,1%,0.125W | 91637 | MFF1816G10000F |
| A1R264 | 321-0193-00 | | | RES.,FXD,FILM:1K OHM,1%,0.125W | 91637 | MFF1816G10000F |
| A1R266 | 321-0188-00 | | | RES.,FXD,FILM:887 OHM,1%,0.125W | 91637 | MFF1816G887R0F |
| A1R268 | 321-0198-00 | | | RES.,FXD,FILM:1.13K OHM,1%,0.125W | 91637 | MFF1816G11300F |
| A1R270 | 315-0681-00 | | | RES.,FXD,CMPSN:680 OHM,5%,0.25W | 01121 | CB6815 |
| A1R272 | 315-0102-00 | | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| A1R281 | 315-0911-00 | | | RES.,FXD,CMPSN:910 OHM,5%,0.25W | 01121 | CB9115 |

| Component No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|
| A1R283 | 315-0121-00 | | | RES.,FXD,CMPSN:120 OHM,5%,0.25W | 01121 | CB1215 |
| A1R285 | 315-0221-00 | | | RES.,FXD,CMPSN:220 OHM,5%,0.25W | 01121 | CB2215 |
| A1R287 | 321-0208-00 | | | RES.,FXD,FILM:1.43K OHM,1%,0.125W | 91637 | MFF1816G14300F |
| A1R288 | 315-0472-00 | | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| A1R290 | 315-0223-00 | | | RES.,FXD,CMPSN:22K OHM,5%,0.25W | 01121 | CB2235 |
| A1R291 | 315-0621-00 | | | RES.,FXD,CMPSN:620 OHM,5%,0.25W | 01121 | CB6215 |
| A1R293 | 315-0472-00 | | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| A1R297 | 321-0171-00 | | | RES.,FXD,FILM:590 OHM,1%,0.125W | 91637 | MFF1816G590ROF |
| A1R298 | 311-1566-00 | | | RES.,VAR,NONWIR:200 OHM,20%,0.50W | 73138 | 91-88-0 |
| A1R300 | 321-0342-00 | | | RES.,FXD,FILM:35.7K OHM,1%,0.125W | 91637 | MFF1816G35701F |
| A1R302 | 321-0269-00 | | | RES.,FXD,FILM:6.19K OHM,1%,0.125W | 91637 | MFF1816G61900F |
| A1R304 | 321-0173-00 | | | RES.,FXD,FILM:619 OHM,1%,0.125W | 91637 | MFF1816G619ROF |
| A1R305 | 321-0263-00 | | | RES.,FXD,FILM:5.36K OHM,1%,0.125W | 91637 | MFF1816G53600F |
| A1R306 | 321-0234-00 | | | RES.,FXD,FILM:2.67K OHM,1%,0.125W | 91637 | MFF1816G26700F |
| A1R308 | 321-0259-00 | | | RES.,FXD,FILM:4.87K OHM,1%,0.125W | 91637 | MFF1816G48700F |
| A1R309 | 321-0098-00 | | | RES.,FXD,FILM:102 OHM,1%,0.125W | 91637 | MFF1816G102ROF |
| A1R311 | 321-0222-00 | | | RES.,FXD,FILM:2K OHM,1%,0.125W | 91637 | MFF1816G20000F |
| A1R313 | 321-0144-00 | | | RES.,FXD,FILM:309 OHM,1%,0.125W | 91637 | MFF1816G309ROF |
| A1R315 | 321-0233-00 | | | RES.,FXD,FILM:2.61K OHM,1%,0.125W | 91637 | MFF1816G26100F |
| A1R316 | 321-0298-00 | | | RES.,FXD,FILM:12.4K OHM,1%,0.125W | 91637 | MFF1816G12401F |
| A1R318 | 321-0222-00 | | | RES.,FXD,FILM:2K OHM,1%,0.125W | 91637 | MFF1816G20000F |
| A1R320 | 311-1562-00 | | | RES.,VAR,NONWIR:2K OHM,20%,0.50W | 73138 | 91-84-0 |
| A1R321 | 321-0231-00 | | | RES.,FXD,FILM:2.49K OHM,1%,0.125W | 91637 | MFF1816G24900F |
| A1R323 | 311-1568-00 | | | RES.,VAR,NONWIR:50 OHM,20%,0.50W | 73138 | 91-90-0 |
| A1R325 | 321-0113-00 | | | RES.,FXD,FILM:147 OHM,1%,0.125W | 91637 | MFF1816G147ROF |
| A1R334 | 321-0230-00 | | | RES.,FXD,FILM:2.43K OHM,1%,0.125W | 91637 | MFF1816G24300F |
| A1R335 | 321-0298-00 | | | RES.,FXD,FILM:12.4K OHM,1%,0.125W | 91637 | MFF1816G12401F |
| A1R336 | 321-0226-00 | | | RES.,FXD,FILM:2.21K OHM,1%,0.125W | 91637 | MFF1816G22100F |
| A1R338 | 321-0259-00 | | | RES.,FXD,FILM:4.87K OHM,1%,0.125W | 91637 | MFF1816G48700F |
| A1R339 | 321-0098-00 | | | RES.,FXD,FILM:102 OHM,1%,0.125W | 91637 | MFF1816G102ROF |
| A1R355 | 315-0511-00 | | | RES.,FXD,CMPSN:510 OHM,5%,0.25W | 01121 | CB5115 |
| A1R363 | 315-0151-00 | | | RES.,FXD,CMPSN:150 OHM,5%,0.25W | 01121 | CB1515 |
| A1S5 | 260-1381-00 | | | SWITCH,PUSH:4 STA,NON-SHORT,INTLK | 71590 | 2KBC040000-618 |
| A1S13 | 260-1943-00 | | | SWITCH,PUSH:2 BTN,2 POLE,TRIG COUPLING | 80737 | 2KBC020000-1 13 |
| A1S111 | 260-1942-00 | | | SWITCH,PUSH:3 BTN,2 POLE,TRIGGER MODE | 80737 | 2KBM030000-1 14 |
| A1S325 | 260-1208-00 | | | SWITCH,PUSH:DPDT,28VDC,PUSH-PUSH | 80009 | 260-1208-00 |
| A1S350 | 260-1211-00 | | | SWITCH,PUSH:1A,28VDC | 80009 | 260-1211-00 |
| A1U45 | 156-0644-03 | | | MICROCIRCUIT,DI:QUAD BILATERAL SW,BURN-IN | 80009 | 156-0644-03 |
| A1U62 | 156-0158-00 | | | MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER | 18324 | MC1458N |
| A1U72 | 156-0251-01 | | | MICROCIRCUIT,LI:HIGH SPEED COMPTR | 18324 | NE529K SUPR1 -B |
| A1U79 | 156-0251-01 | | | MICROCIRCUIT,LI:HIGH SPEED COMPTR | 18324 | NE529K SUPR1 -B |
| A1U95 | 155-0109-01 | | | MICROCIRCUIT,LI:MONOLITHIC TRIGGER | 80009 | 155-0109-01 |
| A1U98 | 156-0724-02 | | | MICROCIRCUIT,DI:HEX INV W/OC OUT,BURN-IN | 01295 | SN74LS05 |
| A1U120 | 156-0479-02 | | | MICROCIRCUIT,DI:QUAD 2-INP ORGATE | 01295 | SN74LS32NP3 |
| A1U135 | 155-0122-00 | | | MICROCIRCUIT,DI:A & B LOGIC | 80009 | 155-0122-00 |
| A1U175 | 156-0067-00 | | | MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER | 02735 | 85145 |
| A1U200 | 156-1149-01 | | | MICROCIRCUIT,LI:OPER AMPL,JFET,BURN-IN | 27014 | LF351N/A+ |
| A1VR20 | 152-0127-00 | | | SEMICOND DEVICE:ZENER,0.4W,7.5V,5% | 04713 | SZG35009K2 |
| A1VR30 | 152-0127-00 | | | SEMICOND DEVICE:ZENER,0.4W,7.5V,5% | 04713 | SZG35009K2 |
| A1VR105 | 152-0195-00 | | | SEMICOND DEVICE:ZENER,0.4W,5.1V,5% | 04713 | SZ11755 |
| A1VR107 | 152-0127-00 | | | SEMICOND DEVICE:ZENER,0.4W,7.5V,5% | 04713 | SZG35009K2 |
| A1VR109 | 152-0127-00 | | | SEMICOND DEVICE:ZENER,0.4W,7.5V,5% | 04713 | SZG35009K2 |
| A1VR233 | 152-0243-00 | | | SEMICOND DEVICE:ZENER,0.4W,15V,5% | 14552 | TD3810983 |
| A1W365 | 131-0566-00 | | | BUS CONDUCTOR:DUMMY RES,2.375,22 AWG | 55210 | L-2007-1 |

| Component No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|
| A2 | ----- ----- | | | CKT BOARD ASSY:DIGITAL | | |
| A2C4 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A2C8 | 281-0759-00 | | | CAP.,FXD,CER DI:22PF,10%,100V | 72982 | 8035D9AADC1G220K |
| A2C40 | 283-0299-00 | | | CAP.,FXD,CER DI:51PF,5%,500V | 72982 | 8121N501C0G510J |
| A2C43 | 283-0299-00 | | | CAP.,FXD,CER DI:51PF,5%,500V | 72982 | 8121N501C0G510J |
| A2C66 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A2C77 | 281-0786-00 | | | CAP.,FXD,CER DI:150PF,10%,100V | 72982 | 8035D2AADX5P151K |
| A2C78 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A2C84 | 281-0775-00 | | | CAP.,FXD,CER DI:0.1UF,20%,50V | 72982 | 8005D9AABZ5U104M |
| A2C93 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A2C115 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A2C121 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A2C124 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A2C130 | 281-0205-00 | | | CAP.,VAR,PLSTC:4-65PF,100V | 80031 | 2810C5R565QJ02F0 |
| A2C141 | 281-0757-00 | | | CAP.,FXD,CER DI:10PF,20%,100V | 72982 | 8035-D-C0G-100G |
| A2C143 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A2C145 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A2C163 | 281-0791-00 | | | CAP.,FXD,CER DI:270PF,10%,100V | 72982 | 8035D2AADX5R271K |
| A2C171 | 290-0804-00 | | | CAP.,FXD,ELCTLT:10UF,+50-10%,25V | 55680 | 25ULA10V-T |
| A2C173 | 290-0804-00 | | | CAP.,FXD,ELCTLT:10UF,+50-10%,25V | 55680 | 25ULA10V-T |
| A2C175 | 290-0804-00 | | | CAP.,FXD,ELCTLT:10UF,+50-10%,25V | 55680 | 25ULA10V-T |
| A2C177 | 281-0775-00 | | | CAP.,FXD,CER DI:0.1UF,20%,50V | 72982 | 8005D9AABZ5U104M |
| A2C179 | 290-0782-00 | | | CAP.,FXD,ELCTLT:4.7UF,+75-10%,35V | 55680 | 35ULA4R7V-T |
| A2C181 | 290-0804-00 | | | CAP.,FXD,ELCTLT:10UF,+50-10%,25V | 55680 | 25ULA10V-T |
| A2C183 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A2C184 | 281-0775-00 | | | CAP.,FXD,CER DI:0.1UF,20%,50V | 72982 | 8005D9AABZ5U104M |
| A2C185 | 281-0773-00 | | | CAP.,FXD,CER DI:0.01UF,10%,100V | 04222 | GC70-1C103K |
| A2CR14 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A2CR25 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A2CR28 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A2CR31 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A2CR36 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A2CR37 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A2CR40 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A2CR43 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A2CR76 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A2CR80 | 152-0141-02 | | | SEMICOND DEVICE:SILICON,30V,150MA | 01295 | 1N4152R |
| A2CR137 | 152-0322-00 | | | SEMICOND DEVICE:SILICON,15V,HOT CARRIER | 50434 | 5082-2672 |
| A2L171 | 108-0245-00 | | | COIL,RF:3.9UH | 76493 | B6310-1 |
| A2L173 | 108-0245-00 | | | COIL,RF:3.9UH | 76493 | B6310-1 |
| A2L175 | 108-0245-00 | | | COIL,RF:3.9UH | 76493 | B6310-1 |
| A2L177 | 108-0245-00 | | | COIL,RF:3.9UH | 76493 | B6310-1 |
| A2L181 | 108-0245-00 | | | COIL,RF:3.9UH | 76493 | B6310-1 |
| A2Q11 | 151-0190-00 | | | TRANSISTOR:SILICON,NPN | 07263 | S032677 |
| A2Q25 | 151-0342-00 | | | TRANSISTOR:SILICON,PNP | 07263 | S035928 |
| A2Q28 | 151-0342-00 | | | TRANSISTOR:SILICON,PNP | 07263 | S035928 |
| A2Q34 | 151-0190-00 | | | TRANSISTOR:SILICON,NPN | 07263 | S032677 |
| A2Q40 | 151-0223-00 | | | TRANSISTOR:SILICON,NPN | 04713 | SPS8026 |
| A2Q43 | 151-0223-00 | | | TRANSISTOR:SILICON,NPN | 04713 | SPS8026 |
| A2Q52 | 151-0190-00 | | | TRANSISTOR:SILICON,NPN | 07263 | S032677 |
| A2Q54 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 04713 | SPS6868K |
| A2Q76 | 151-0223-00 | | | TRANSISTOR:SILICON,NPN | 04713 | SPS8026 |
| A2Q93 | 151-0190-00 | | | TRANSISTOR:SILICON,NPN | 07263 | S032677 |
| A2Q110 | 151-0190-00 | | | TRANSISTOR:SILICON,NPN | 07263 | S032677 |
| A2Q123 | 151-0190-00 | | | TRANSISTOR:SILICON,NPN | 07263 | S032677 |
| A2R1 | 315-0272-00 | | | RES.,FXD,CMPSN:2.7K OHM,5%,0.25W | 01121 | CB2725 |
| A2R3 | 315-0332-00 | | | RES.,FXD,CMPSN:3.3K OHM,5%,0.25W | 01121 | CB3325 |

| Component No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|
| A2R5 | 315-0272-00 | | | RES.,FXD,CMPSN:2.7K OHM,5%,0.25W | 01121 | CB2725 |
| A2R7 | 315-0332-00 | | | RES.,FXD,CMPSN:3.3K OHM,5%,0.25W | 01121 | CB3325 |
| A2R10 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| A2R12 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| A2R13 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| A2R16 | 321-0306-00 | | | RES.,FXD,FILM:15K OHM,1%,0.125W | 91637 | MFF1816G15001F |
| A2R17 | 311-1559-00 | | | RES.,VAR,NONWIR:10K OHM,20%,0.50W | 73138 | 91-81-0 |
| A2R19 | 311-1556-00 | | | RES.,VAR,NONWIR:50K OHM,20%,0.50W | 73138 | 91-78-0 |
| A2R20 | 315-0754-00 | | | RES.,FXD,CMPSN:750K OHM,5%,0.25W | 01121 | CB7545 |
| A2R22 | 321-0289-00 | | | RES.,FXD,FILM:10K OHM,1%,0.125W | 91637 | MFF1816G10001F |
| A2R25 | 321-0270-00 | | | RES.,FXD,FILM:6.34K OHM,1%,0.125W | 91637 | MFF1816G63400F |
| A2R28 | 321-0270-00 | | | RES.,FXD,FILM:6.34K OHM,1%,0.125W | 91637 | MFF1816G63400F |
| A2R30 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| A2R32 | 315-0183-00 | | | RES.,FXD,CMPSN:18K OHM,5%,0.25W | 01121 | CB1835 |
| A2R33 | 315-0273-00 | | | RES.,FXD,CMPSN:27K OHM,5%,0.25W | 01121 | CB2735 |
| A2R35 | 315-0563-00 | | | RES.,FXD,CMPSN:56K OHM,5%,0.25W | 01121 | CB5635 |
| A2R38 | 322-0247-00 | | | RES.,FXD,FILM:3.65K OHM,1%,0.25W | 16299 | NA60 |
| A2R39 | 321-0186-00 | | | RES.,FXD,FILM:845 OHM,1%,0.125W | 91637 | MFF1816G845R0F |
| A2R45 | 322-0247-00 | | | RES.,FXD,FILM:3.65K OHM,1%,0.25W | 16299 | NA60 |
| A2R46 | 321-0186-00 | | | RES.,FXD,FILM:845 OHM,1%,0.125W | 91637 | MFF1816G845R0F |
| A2R47 | 315-0102-00 | | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| A2R49 | 321-0282-00 | | | RES.,FXD,FILM:8.45K OHM,1%,0.125W | 91637 | MFF1816G84500F |
| A2R50 | 321-0343-00 | | | RES.,FXD,FILM:36.5K OHM,1%,0.125W | 91637 | MFF1816G36501F |
| A2R52 | 315-0152-00 | | | RES.,FXD,CMPSN:1.5K OHM,5%,0.25W | 01121 | CB1525 |
| A2R55 | 315-0222-00 | | | RES.,FXD,CMPSN:2.2K OHM,5%,0.25W | 01121 | CB2225 |
| A2R57 | 315-0472-00 | | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| A2R60 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| A2R62 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| A2R64 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| A2R75 | 315-0102-00 | | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| A2R76 | 315-0102-00 | | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| A2R78 | 315-0102-00 | | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| A2R79 | 315-0102-00 | | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| A2R81 | 315-0102-00 | | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| A2R83 | 315-0202-00 | | | RES.,FXD,CMPSN:2K OHM,5%,0.25W | 01121 | CB2025 |
| A2R92 | 315-0101-00 | | | RES.,FXD,CMPSN:100 OHM,5%,0.25W | 01121 | CB1015 |
| A2R94 | 315-0101-00 | | | RES.,FXD,CMPSN:100 OHM,5%,0.25W | 01121 | CB1015 |
| A2R112 | 321-0260-00 | | | RES.,FXD,FILM:4.99K OHM,1%,0.125W | 91637 | MFF1816G49900F |
| A2R114 | 321-0323-00 | | | RES.,FXD,FILM:22.6K OHM,1%,0.125W | 91637 | MFF1816G22601F |
| A2R115 | 311-1560-00 | | | RES.,VAR,NONWIR:5K OHM,20%,0.50W | 73138 | 91-82-0 |
| A2R116 | 321-0354-00 | | | RES.,FXD,FILM:47.5K OHM,1%,0.125W | 91637 | MFF1816G47501F |
| A2R120 | 315-0102-00 | | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| A2R122 | 315-0101-00 | | | RES.,FXD,CMPSN:100 OHM,5%,0.25W | 01121 | CB1015 |
| A2R123 | 315-0753-00 | | | RES.,FXD,CMPSN:75K OHM,5%,0.25W | 01121 | CB7535 |
| A2R125 | 321-0241-00 | | | RES.,FXD,FILM:3.16K OHM,1%,0.125W | 91637 | MFF1816G31600F |
| A2R131 | 321-0236-00 | | | RES.,FXD,FILM:2.8K OHM,1%,0.125W | 91637 | MFF1816G28000F |
| A2R133 | 311-1557-00 | | | RES.,VAR,NONWIR:25K OHM,20%,0.50W | 73138 | 91-79-0 |
| A2R135 | 315-0513-00 | | | RES.,FXD,CMPSN:51K OHM,5%,0.25W | 01121 | CB5135 |
| A2R137 | 315-0102-00 | | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| A2R139 | 315-0751-00 | | | RES.,FXD,CMPSN:750 OHM,5%,0.25W | 01121 | CB7515 |
| A2R146 | 315-0563-00 | | | RES.,FXD,CMPSN:56K OHM,5%,0.25W | 01121 | CB5635 |
| A2R157 | 315-0433-00 | | | RES.,FXD,CMPSN:43K OHM,5%,0.25W | 01121 | CB4335 |
| A2R158 | 315-0472-00 | | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| A2R159 | 315-0104-00 | | | RES.,FXD,CMPSN:100K OHM,5%,0.25W | 01121 | CB1045 |
| A2R161 | 315-0203-00 | | | RES.,FXD,CMPSN:20K OHM,5%,0.25W | 01121 | CB2035 |
| A2R163 | 315-0562-00 | | | RES.,FXD,CMPSN:5.6K OHM,5%,0.25W | 01121 | CB5625 |
| A2U5 | 156-0382-02 | | | MICROCIRCUIT,DI:QUAD 2-INP NAND GATE | 01295 | SN74LS00 |

| Component No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|
| A2U22 | 156-0067-13 | | | MICROCIRCUIT,LI:OPNL AMPL,SELECTED | 04713 | MC1741CUDS |
| A2U25 | 156-0158-00 | | | MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER | 18324 | MC1458N |
| A2U68 | 156-0410-00 | | | MICROCIRCUIT,DI:COUNTER TIME BASE | 50088 | MK5009P |
| A2U70 | 156-0382-02 | | | MICROCIRCUIT,DI:QUAD 2-INP NAND GATE | 01295 | SN74LS00 |
| A2U75 | 156-0387-02 | | | MICROCIRCUIT,DI:DUAL J-K FF,BURN IN | 01295 | SN74LS73 |
| A2U83 | 156-0733-02 | | | MICROCIRCUIT,DI:DUAL MONOSTABLE MV,BURN-IN | 04713 | SN74LS221N/J |
| A2U86 | 156-0656-02 | | | MICROCIRCUIT,DI:DECADE COUNTER,BURN-IN | 01295 | SN74LS90 |
| A2U88 | 156-0383-02 | | | MICROCIRCUIT,DI:QUAD 2-INP NOR GATE | 01295 | SN74LS02 |
| A2U90 | 156-0388-03 | | | MICROCIRCUIT,DI:DUAL D FLIP-FLOP | 07263 | 74LS74A |
| A2U101 | 156-0385-02 | | | MICROCIRCUIT,DI:HEX INVERTER | 01295 | SN74LS04 |
| A2U103 | 156-0646-02 | | | MICROCIRCUIT,DI:4 BIT BINARY COUNTER | 01295 | SN74LS93 |
| A2U105 | 156-0646-02 | | | MICROCIRCUIT,DI:4 BIT BINARY COUNTER | 01295 | SN74LS93 |
| A2U107 | 156-0646-02 | | | MICROCIRCUIT,DI:4 BIT BINARY COUNTER | 01295 | SN74LS93 |
| A2U109 | 156-0927-02 | | | MICROCIRCUIT,LI:DIGITAL/ANALOG CONVERTER | 80009 | 156-0927-02 |
| A2U142 | 156-0251-01 | | | MICROCIRCUIT,LI:HIGH SPEED COMPTR | 18324 | NE529K SUPR1 -B |
| A2U155 | 156-0875-02 | | | MICROCIRCUIT,DI:DUAL 2-W/2 INP AOI GATES | 01295 | SN74LS51 |
| A2VR66 | 152-0395-00 | | | SEMICOND DEVICE:ZENER,0.4W,4.3V,5% | 14552 | TD332317 |
| A2VR145 | 152-0127-00 | | | SEMICOND DEVICE:ZENER,0.4W,7.5V,5% | 04713 | SZG35009K2 |
| A2Y8 | 158-0168-00 | | | XTAL UNIT,QTZ:2.0 MHZ,0.01%,PAR | 33096 | OBD |

| Component No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|
| | | | | CHASSIS PARTS | | |
| DS15 | 150-1029-00 | | | LT EMITTING DIO:GREEN,565NM,35MA | 53184 | XC209G |
| DS25 | 150-1036-00 | | | LAMP,LED:RED,3.0V,40MA | 01295 | TIL 209A |
| R10 | 311-2040-00 | | | RES,,VAR,NONWIR:PNL,5K OHM,20%,0.5W | 12697 | CM41745 |
| R23 | 311-1482-00 | | | RES.,VAR,NONWIR:5K OHM,20%,0.50W | 01121 | W-8070 |
| R170 | 311-1803-00 | | | RES.,VAR,NONWIR:20K OHM,10%,1W | 01121 | 13M501 |
| R341 | 311-2063-00 | | | RES.,VAR,NONWIR:CKT BD,20K OHM,20%,0.25W | 12697 | MODEL388 |
| S11 | 311-2040-00 | | | RES.,VAR,NONWIR:PNL,5K OHM,20%,0.5W | 12697 | CM41745 |
| S20 | 263-1175-00 | | | SW,CAM ACTR AS:TIMING | 80009 | 263-1175-00 |
| S170A,B | 311-1803-00 | | | RES.,VAR,NONWIR:20K OHM,10%,1W | 01121 | 13M501 |

# DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

## Symbols

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The overline on a signal name indicates that the signal performs its intended function when it is in the low state.

Abbreviations are based on ANSI Y1.1-1972.

Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

| | |
|---|---|
| Y14.15, 1966 | Drafting Practices. |
| Y14.2, 1973 | Line Conventions and Lettering. |
| Y10.5, 1968 | Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering. |

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

## Component Values

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

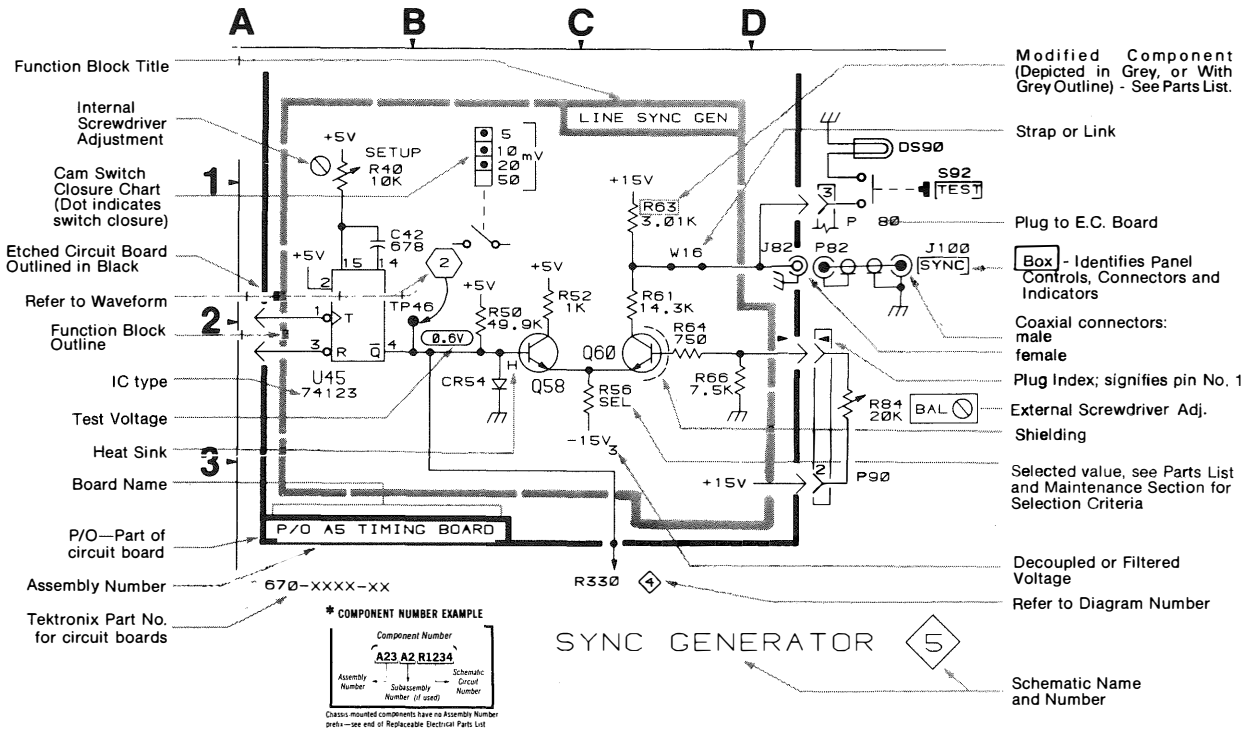
Capacitors = Values one or greater are in picofarads (pF). Values less than one are in microfarads ($\mu$F).
Resistors = Ohms ($\Omega$).

## The information and special symbols below may appear in this manual.

### Assembly Numbers and Grid Coordinates

Each assembly in the instrument is assigned an assembly number (e.g., A20). The assembly number appears on the circuit board outline on the diagram, in the title for the circuit board component location illustration, and in the lookup table for the schematic diagram and corresponding component locator illustration. The Replaceable Electrical Parts list is arranged by assemblies in numerical sequence; the components are listed by component number *(see following illustration for constructing a component number).

The schematic diagram and circuit board component location illustration have grids. A lookup table with the grid coordinates is provided for ease of locating the component. Only the components illustrated on the facing diagram are listed in the lookup table. When more than one schematic diagram is used to illustrate the circuitry on a circuit board, the circuit board illustration may only appear opposite the first diagram on which it was illustrated; the lookup table will list the diagram number of other diagrams that the circuitry of the circuit board appears on.



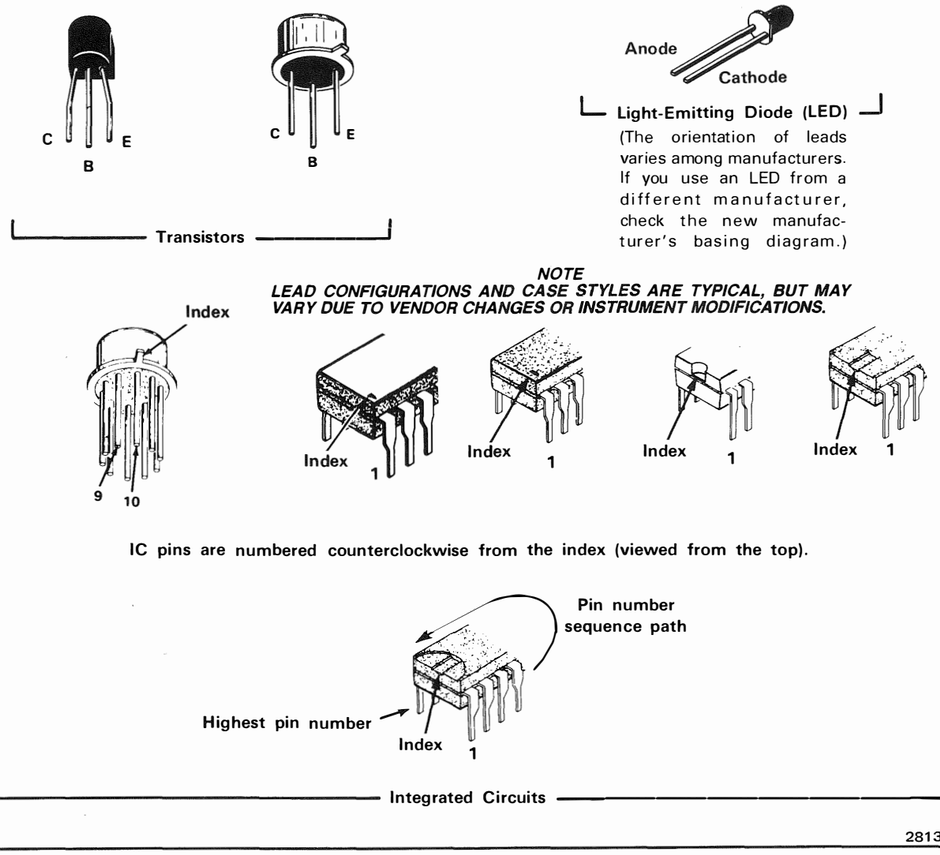



Figure 8-1. Semiconductor Lead Configurations.

## CHASSIS MOUNTED PARTS

| CIRCUIT NUMBER | SCHEM NUMBER | SCHEM LOCATION |
|---|---|---|
| DS15 | 2 | E4 |
| DS25 | 5 | G5 |
| J9 | 1 | A2 |
| J18 | 3 | G2 |
| J29 | 6 | G5 |
| P10 | 1 | A3 |
| P11 | 1 | A5 |
| R10 | 1 | A4 |
| R23 | 4 | C4 |
| S11 | 1 | A5 |

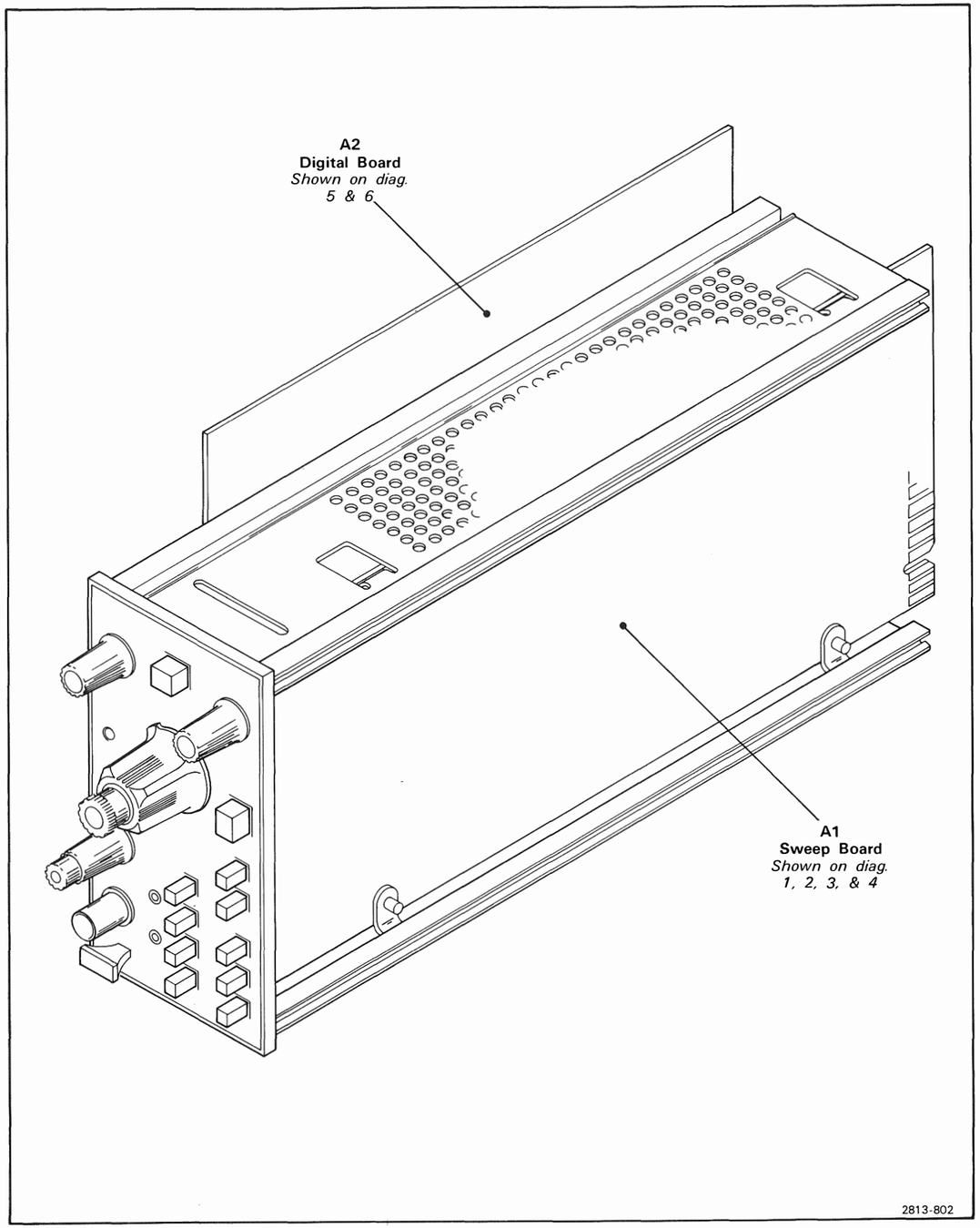



Figure 8-2. 5B25N Circuit Board Locations.

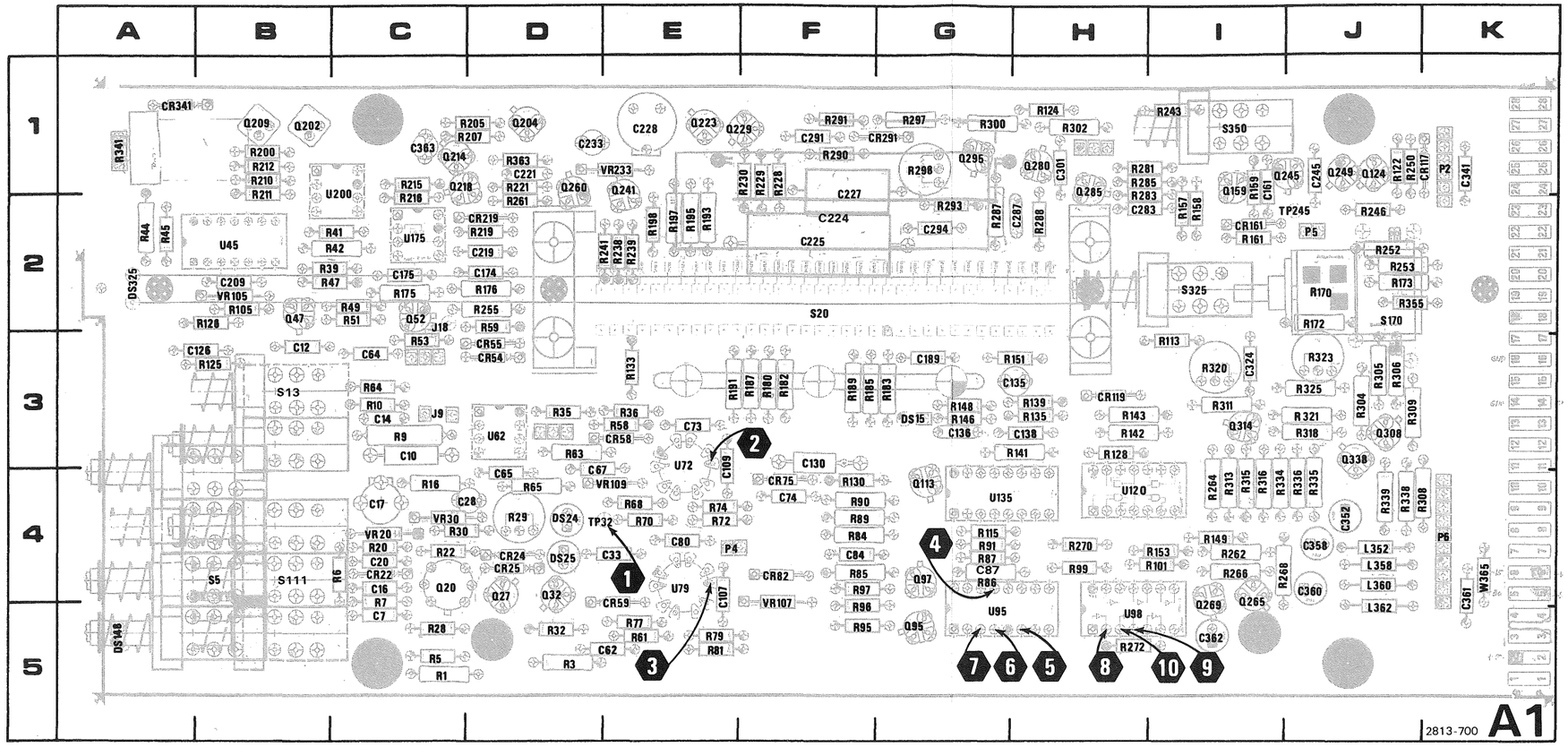
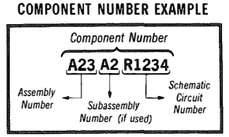



Figure 8-3. A1-Sweep circuit board assembly.

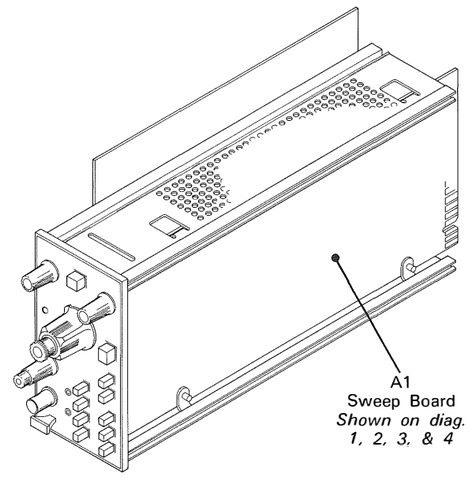
Static Sensitive Devices
*See Maintenance Section*

**COMPONENT NUMBER EXAMPLE**




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

@



A1
Sweep Board
*Shown on diag. 1, 2, 3, & 4*

## TRIGGER DIAGRAM 1

### ASSEMBLY A1

| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
|---|---|---|
| C7 | A2 | C5 |
| C10 | A2 | C3 |
| C12 | B2 | B3 |
| C14 | B2 | C3 |
| C16 | B2 | C4 |
| C17 | C2 | C4 |
| C20 | C2 | C4 |
| C28 | C3 | D4 |
| C33 | C3 | E4 |
| C62 | C5 | E5 |
| C64 | B5 | C3 |
| C65 | B4 | D4 |
| C67 | C4 | D4 |
| C73 | D3 | E3 |
| C74 | D4 | F4 |
| C80 | E4 | E4 |
| C84 | E4 | F4 |
| C107 | F2 | E4 |
| C109 | F1 | E3 |
| CR22 | C2 | C4 |
| CR24 | C2 | D4 |
| CR25 | C2 | D4 |
| CR54 | C5 | D3 |
| CR55 | C5 | D3 |
| CR58 | D5 | E3 |
| CR59 | D5 | E5 |
| CR75 | E4 | F4 |
| CR82 | E4 | F4 |
| DS24 | C2 | D4 |
| DS25 | C2 | D4 |
| P4 | G2 | E4 |
| Q20A | C2 | C4 |
| Q20B | C3 | C4 |
| Q27 | C2 | D4 |
| Q32 | C3 | D4 |
| Q47 | B5 | B2 |
| Q52 | B5 | C2 |
| Q95 | G3 | G5 |
| Q97 | G4 | G4 |
| R1 | A1 | C5 |
| R3 | A1 | D5 |
| R5 | A2 | C5 |
| R6 | A2 | C4 |
| R7 | A2 | C4 |
| R9 | A2 | C3 |
| R10 | A2 | C3 |
| R16 | B2 | C4 |
| R20 | C2 | C4 |
| R22 | C2 | C4 |
| R28 | C3 | C5 |
| R29 | C3 | D4 |
| R30 | C3 | C4 |
| R32 | C2 | D5 |
| R35 | A3 | D3 |
| R36 | A3 | E3 |
| R39 | B4 | C2 |
| R41 | B4 | C2 |
| R42 | B4 | C2 |
| R44 | B4 | A2 |
| R45 | B4 | A2 |
| R47 | B4 | C2 |
| R49 | B5 | C2 |
| R51 | C5 | C2 |
| R53 | C5 | C3 |
| R58 | D5 | E3 |
| R59 | E5 | D2 |
| R61 | C4 | E5 |
| R63 | C4 | D3 |
| R64 | B4 | C3 |
| R65 | B4 | D4 |
| R68 | C4 | E4 |
| R70 | D3 | E4 |
| R72 | D3 | E4 |
| R74 | D4 | E4 |
| R77 | D4 | E5 |
| R79 | E4 | E5 |
| R81 | E5 | E5 |
| R84 | E4 | F4 |
| R85 | F4 | F4 |
| R86 | F4 | G4 |
| R87 | F4 | G4 |
| R89 | F3 | F4 |
| R90 | F3 | F4 |
| R91 | F3 | G4 |
| R95 | F4 | F5 |
| R96 | G3 | F5 |
| R97 | G4 | F4 |
| R99 | G5 | H4 |
| R101 | G4 | I4 |
| R105 | F2 | B2 |
| S5 | A1 | B4 |
| S13 | B1 | B3 |
| S20 | E5 | F2 |
| TP32 | D3 | D4 |
| U45A | B5 | B2 |
| U45B | B5 | B2 |
| U45C | B4 | B2 |
| U45D | B5 | B2 |
| U62A | C5 | D3 |
| U62B | C4 | D3 |
| U72 | D4 | E3 |
| U79 | D5 | E4 |
| U95 | F4 | G5 |
| U98A | G4 | H5 |
| U98B | G4 | H5 |
| VR20 | C2 | C4 |
| VR30 | C3 | C4 |
| VR105 | F2 | B2 |
| VR107 | F2 | F4 |
| VR109 | F1 | E4 |

*Partial A1 also shown on diagrams 2, 3, 4, 6 and 7.*

### CHASSIS MOUNTED PARTS

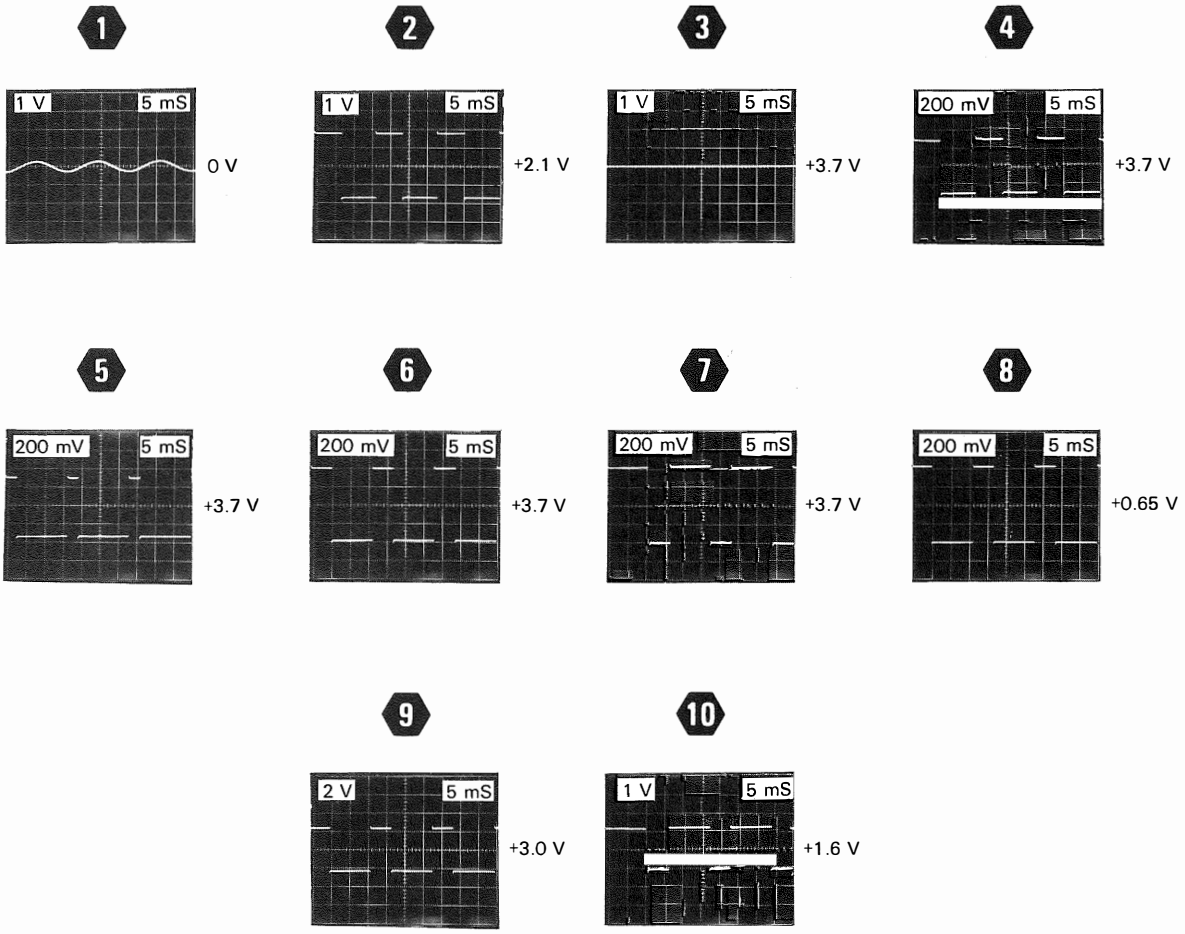
| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
|---|---|---|
| J9 | A2 | CHASSIS |
| P10 | A3 | CHASSIS |
| P11 | A5 | CHASSIS |
| R10 | A4 | CHASSIS |
| S11 | A5 | CHASSIS |

## VOLTAGE AND WAVEFORM CONDITIONS

The 5B25N Digitizer Time Base/Ampl was installed in a Tektronix 5000 Series mainframe (Tektronix 5440 Oscilloscope). The 5B25N controls were set as follows: TIME/DIV (1 ms); SOURCE (LINE); COUPLING (AC); MODE (AUTO); DISPLAY (CH); SLOPE (+); PRETRIGGER (MIDRANGE); CAL (FULL CW).

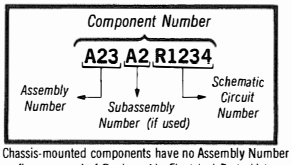
**Waveform Measurement Equipment.** The waveforms shown below were obtained using a test oscilloscope system with 10 MΩ input impedance, at least 60 MHz bandwidth and 10X probe (Tektronix 7603 Oscilloscope, 7B80 Time Base, 7A13 Differential Comparator and P6106 Probe).

**Voltage Measurement Equipment.** The voltages were taken with the above oscilloscope system or a digital multimeter with 10 MΩ input impedance (Tektronix DM 501A Option 02 Digital Multimeter installed in a TM501 Power Module).

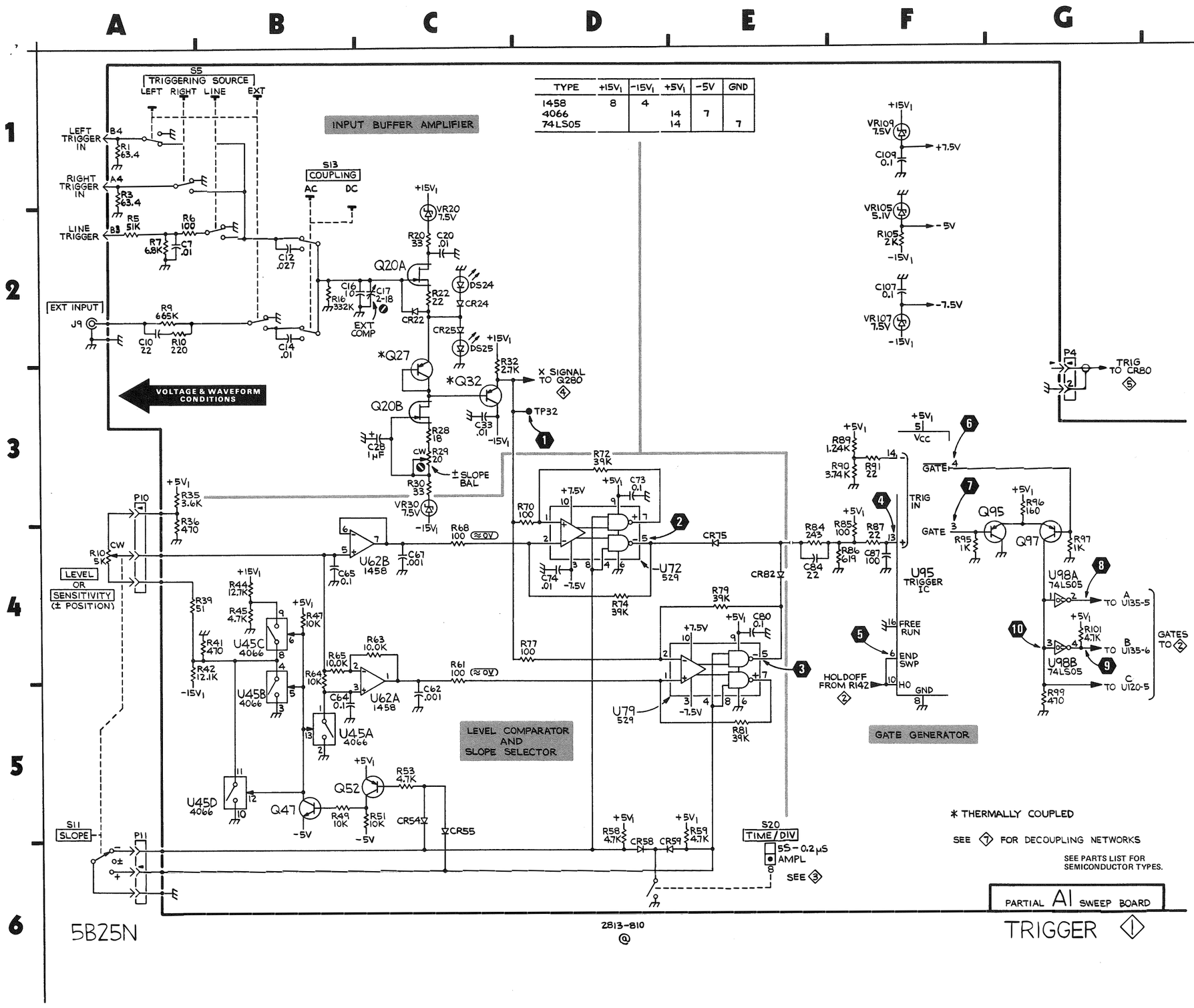



**Static Sensitive Devices**
*See Maintenance Section*

**COMPONENT NUMBER EXAMPLE**




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


A
B
C
D
E
F
G
H
1
2
3
4
5
6
S5
TRIGGERING SOURCE
LEFT RIGHT LINE EXT
INPUT BUFFER AMPLIFIER
TYPE | +15V1 | -15V1 | +5V1 | -5V | GND
1458 | 8 | 4 | | |
4066 | | | 14 | 7 |
74LS05 | | | 14 | | 7
LEFT TRIGGER IN
RIGHT TRIGGER IN
LINE TRIGGER
EXT INPUT
J9
R1 63.4
R3 63.4
R5 51K
R6 100
R7 6.8K
C7 .01
C10 22
R9 665K
R10 220
C12 .027
C14 .01
S13
COUPLING
AC DC
C16 10
C17 2-18
EXT COMP
R16 332K
VOLTAGE & WAVEFORM CONDITIONS
+15V1
VR20 7.5V
R20 33
C20 .01
Q20A
Q20B
DS24
CR24
CR22
CR25
DS25
*Q27
*Q32
R22 22
R32 2.7K
X SIGNAL TO Q280
TP32
C33 .01
-15V1
C28 1mfd
R28 18
R29 20
± SLOPE BAL
R30 33
VR30 7.5V
R72 39K
+5V1
C73 .01
+7.5V
R70 100
U72 529
C74 .01
-7.5V
R74 39K
CR75
R68 100 (≈0V)
U62B 1458
C65 0.1
C67 .001
P10
P11
+5V1
R35 3.6K
R36 470
R10 5K CW
LEVEL OR SENSITIVITY (± POSITION)
R39 51
R41 470
R42 12.1K
-15V1
+15V1
R44 12.7K
R45 4.7K
U45C 4066
+5V1
R47 10K
U45B 4066
R63 10.0K
R65 10.0K
R64 10K
C64 0.1
U62A 1458
R61 100 (≈0V)
C62 .001
U45A 4066
LEVEL COMPARATOR AND SLOPE SELECTOR
R77 100
R79 39K
+7.5V
+5V1
C80 0.1
U79 529
-7.5V
R81 39K
CR82
U45D 4066
Q52
Q47
R53 4.7K
R49 10K
R51 10K
CR54
CR55
-5V
S11
SLOPE
R58 4.7K
CR58
CR59
R59 4.7K
S20
TIME / DIV
5S - 0.2 µS
AMPL
SEE 3
2813-810
+15V1
VR109 7.5V
C109 0.1
+7.5V
VR105 5.1V
R105 2K
-5V
C107 0.1
-7.5V
VR107 7.5V
P4
TRIG TO CR80
+5V1
R89 1.24K
R90 3.74K
R91 22
+5V1
Vcc
GATE
R84 243
C84 22
R85 100
R86 619
R87 22
C87 100
TRIG IN
U95 TRIGGER IC
FREE RUN
END SWP
HO
GND
HOLDOFF FROM R142
Q95
Q97
R96 160
R95 1K
R97 1K
U98A 74LS05
U98B 74LS05
R101 4.7K
R99 470
TO A U135-5
TO B U135-6
TO C U120-5
GATES TO 2
GATE GENERATOR
* THERMALLY COUPLED
SEE 7 FOR DECOUPLING NETWORKS
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
PARTIAL A1 SWEEP BOARD
TRIGGER 1
5B25N
Q

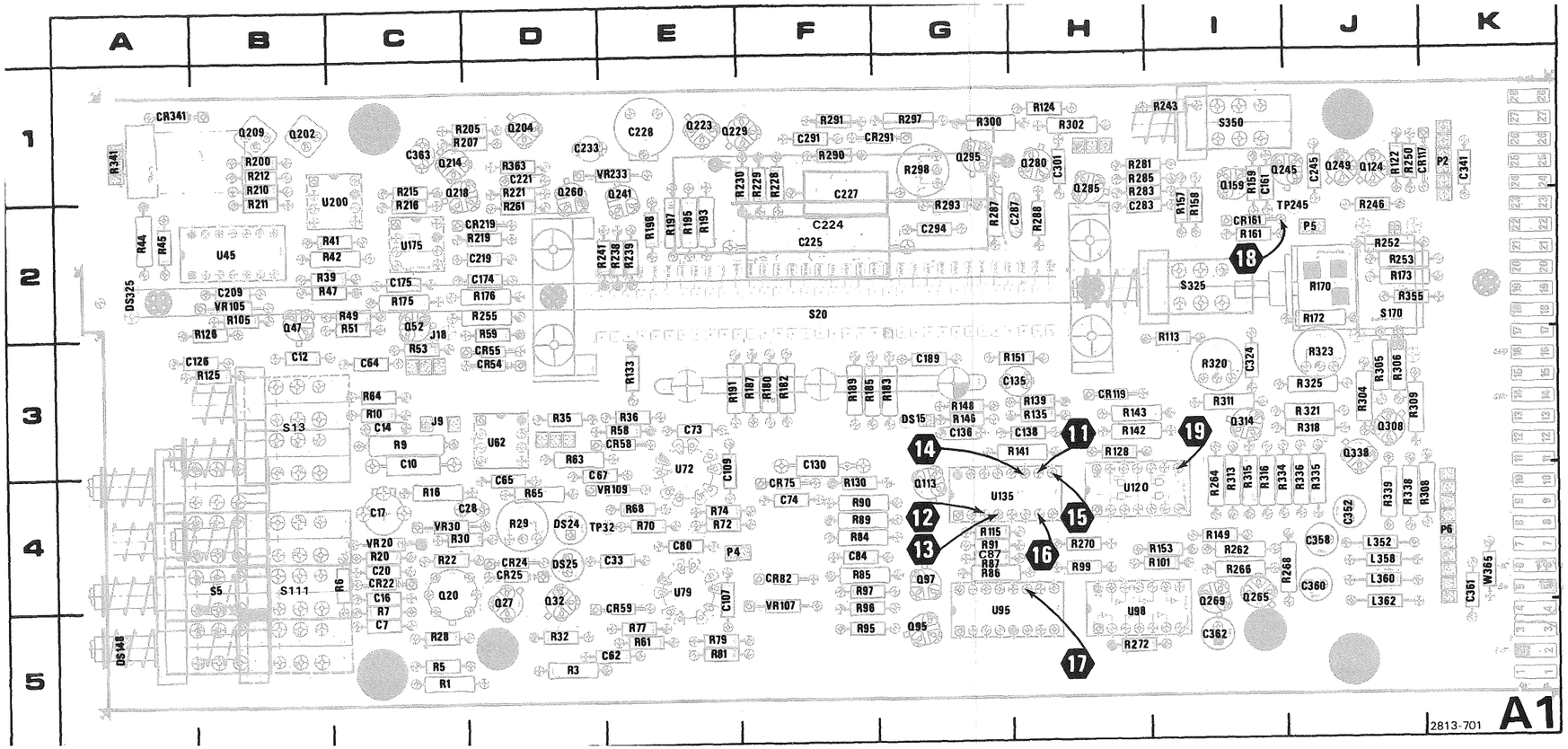



Figure 8-4. A1-Sweep circuit board assembly.

Static Sensitive Devices
*See Maintenance Section*

**COMPONENT NUMBER EXAMPLE**

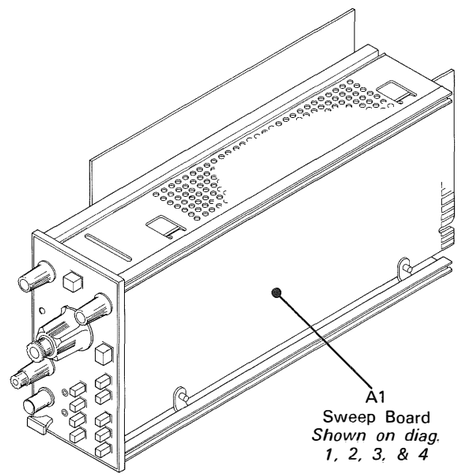
*Component Number*

**A23 A2 R1234**

*Assembly Number* — *Subassembly Number (if used)* — *Schematic Circuit Number*

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

@



## SWEEP CONTROL DIAGRAM 2

### ASSEMBLY A1

| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
|---|---|---|---|---|---|
| C126 | C4 | B3 | R133 | C3 | E3 |
| C130 | C4 | F3 | R135 | D2 | H3 |
| C135 | D2 | H3 | R139 | D2 | H3 |
| C136 | D3 | G3 | R141 | D3 | H3 |
| C138 | D3 | H3 | R142 | E3 | H3 |
| C161 | F5 | I1 | R143 | E3 | H3 |
| | | | R146 | E4 | G3 |
| CR117 | B4 | K1 | R148 | E4 | G3 |
| CR119 | B5 | H3 | R149 | E4 | I4 |
| CR161 | F5 | I2 | R151 | F4 | H3 |
| | | | R153 | F4 | I4 |
| DS148 | E4 | A5 | R157 | E5 | I2 |
| | | | R158 | E5 | I2 |
| P6 | G6 | K4 | R159 | E5 | I1 |
| | | | R161 | F5 | I2 |
| Q113 | A4 | G4 | | | |
| Q124 | C4 | J1 | S20 | F1 | F2 |
| Q159 | F5 | I1 | S111 | B3 | B4 |
| | | | | | |
| R113 | B4 | I3 | U98D | D5 | H5 |
| R115 | B4 | G4 | U98E | F5 | H5 |
| R122 | C4 | J1 | U98F | E6 | H5 |
| R124 | C4 | H1 | U120A | F5 | H4 |
| R125 | C4 | B3 | U120B | E5 | H4 |
| R126 | C4 | B2 | U120C | E5 | H4 |
| R128 | C4 | H3 | U120D | C4 | H4 |
| R130 | C3 | F4 | U135 | D4 | G4 |

*Partial A1 also shown on diagrams 1, 3, 4, 6 and 7.*

### CHASSIS MOUNTED PARTS

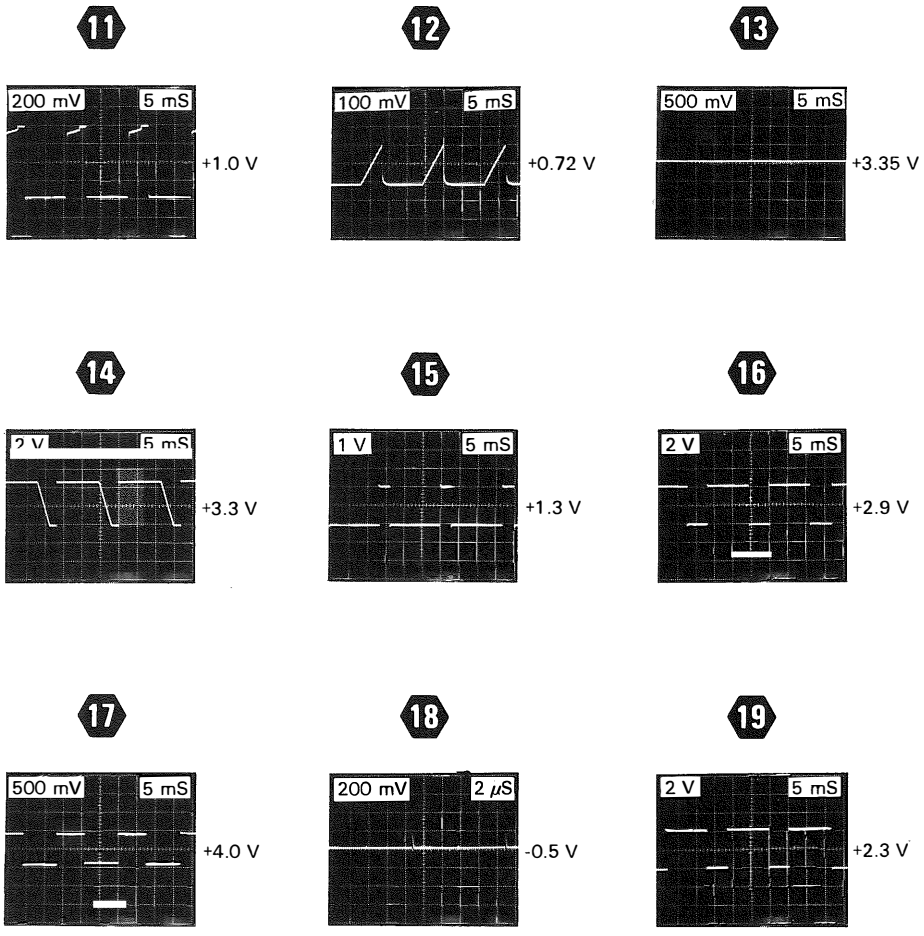
| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
|---|---|---|---|---|---|
| DS15 | E4 | CHASSIS | | | |

## VOLTAGE AND WAVEFORM CONDITIONS

The 5B25N Digitizer Time Base/Ampl was installed in a Tektronix 5000 Series mainframe (Tektronix 5440 Oscilloscope). The 5B25N controls were set as follows: TIME/DIV (1 ms); SOURCE (LINE); COUPLING (AC); MODE (AUTO); DISPLAY (CH); SLOPE (+); PRETRIGGER (MIDRANGE); CAL (FULL CW).

**Waveform Measurement Equipment.** The waveforms shown below were obtained using a test oscilloscope system with 10 MΩ input impedance, at least 60 MHz bandwidth and 10X probe (Tektronix 7603 Oscilloscope, 7B80 Time Base, 7A13 Differential Comparator and P6106 Probe).

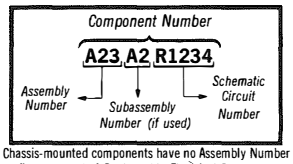
**Voltage Measurement Equipment.** The voltages were taken with the above oscilloscope system or a digital multimeter with 10 MΩ input impedance (Tektronix DM 501A Option 02 Digital Multimeter installed in a TM501 Power Module).






**Static Sensitive Devices**
*See Maintenance Section*

**COMPONENT NUMBER EXAMPLE**




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

| TYPE | Vcc +5V1 | GND |
|---|---|---|
| 74LS32 | 14 | 7 |
| 74LS05 | 14 | 7 |

SEE ⑦ FOR DECOUPLING NETWORKS

AMPL 5 2 1 .5 .2 .1 S
50 20 10 5 2 1 .5 .2 .1 mS
50 20 10 5 2 1 .5 .2 µS

S20 TIME/DIV SEE ③

34 7 21 20 32

VOLTAGE & WAVEFORM CONDITIONS

+15V1 R133 10K
+15V1 R135 91K
C135 10µF
+15V1 R139 2.7K
C136 0.1
C138 .001
+5V1

S111 MODE: AUTO NORM SINGLE SWEEP RESET

+5V1 R130 470K
+5V1 R128 4.7K
U120D 74LS32
C130 0.22

HO TIM 10
HO START 12
HO RAMP 11
HO OUT 9
Vcc 16
AUTO TIM 3
AUTO MODE 4
S.S. MODE 1

R142 3.40K
R143 1.62K
HOLDOFF TO U95-10,6 ①
R141 2.00K

+5V1 DSI5 TRIG'D
R146 220
TRIG LITE 13

+5V1 DSI48 SINGLE SWEEP READY
R148 220
LITE GND 14
READY LITE 15

+5V1 R126 470K
C126 0.1
S.S RESET 2

R125 100K
R124 100
Q124
R122 10K

U135 SWEEP CONTROL IC
A GATE 7
+5V1 R149 1K

+5V1 R133 2K
R115 4.7K
Q113
SINGLE SWEEP MODE A12
SINGLE SWEEP RESET B17
CR117

LOCKOUT (B SWP) A16
LOCKOUT (A SWP) A17
CR119

GATES FROM ①
A FROM U98-2 5 LOGIC GATE
B FROM U98-4 6 AUTO GATE
C FROM Q97
GND B1

SWP END FROM Q269 ③
U98D 74LS05

+5V1 R151 1.5K
U120A 74LS32
+5V1 R153 2K
U98E 74LS05

A9 Z AXIS (A SWP)
B10 Z AXIS (B SWP)
B15 ALTERNATE DRIVE
A10 A GATE
P6

+15V1 R159 6.2K
C161 330
+5V1 R157 2K
R158 4.7K
Q159
R161 1.5K
CR161
U120B 74LS32
U120C 74LS32

GATE TO U42-4 & U101-13 ⑥
GATE TO R216 ③
U98F 74LS05

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

PARTIAL A1 SWEEP BOARD

5B25N

2813-811 @

SWEEP CONTROL ②

② Sweep Control | Reverse Side A1

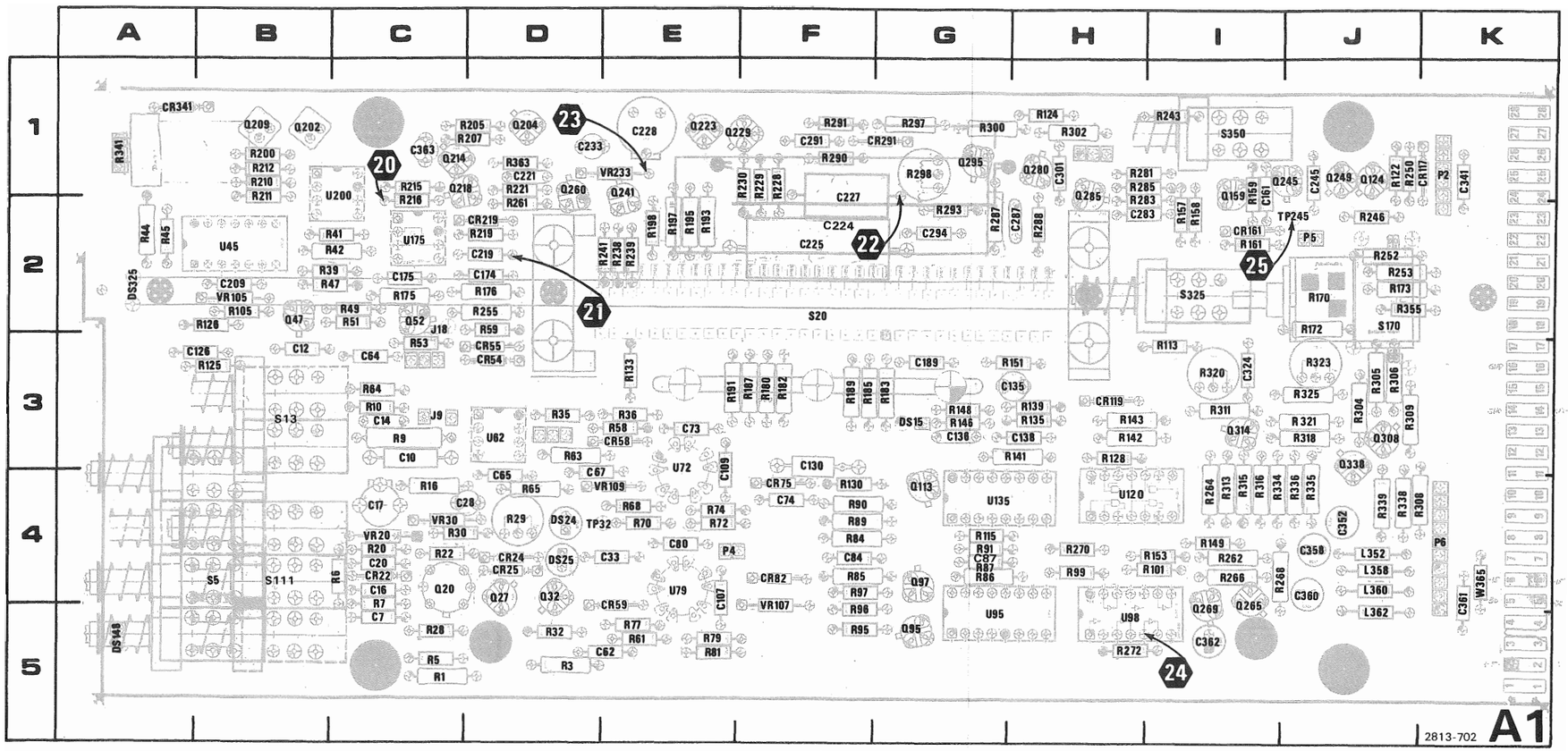
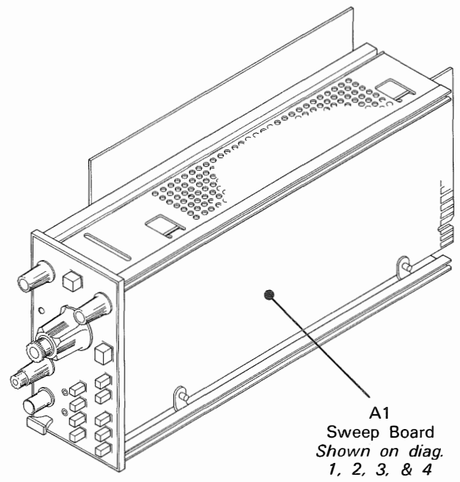
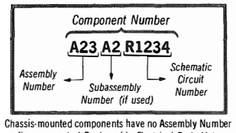



Figure 8-5. A1–Sweep circuit board assembly.




Static Sensitive Devices
*See Maintenance Section*

**COMPONENT NUMBER EXAMPLE**




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

@

## SWEEP AND TIMING DIAGRAM 3

### ASSEMBLY A1

| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
|---|---|---|---|---|---|
| C174 | B2 | D2 | R191 | B2 | E3 |
| C175 | B2 | C2 | R193 | B2 | E2 |
| C189 | B3 | G3 | R195 | B3 | E2 |
| C209 | C3 | B2 | R197 | B3 | E2 |
| C219 | D2 | D2 | R198 | B3 | E2 |
| C221 | E2 | D1 | R200 | C2 | B1 |
| C224 | D3 | F2* | R205 | C3 | D1 |
| C225 | D3 | F2 | R207 | D3 | D1 |
| C227 | D3 | F1 | R210 | C2 | B1 |
| C228 | E3 | E1 | R211 | C2 | B1 |
| C233 | E2 | D1 | R212 | C2 | B1 |
| C245 | F1 | J1 | R215 | D2 | C1 |
| | | | R216 | D2 | C2 |
| CR219 | D2 | D2 | R219 | D2 | D2 |
| | | | R221 | E2 | D1 |
| P2 | A1 | K1 | R228 | E3 | F1 |
| P5 | G1 | J2 | R229 | E3 | F1 |
| P6 | B1 | K4 | R230 | E3 | F1 |
| P6 | G3 | K4 | R238 | E1 | E2 |
| | | | R239 | E1 | E2 |
| Q202 | C3 | B1 | R241 | E1 | E2 |
| Q204 | C3 | D1 | R243 | E1 | I1 |
| Q209 | C2 | B1 | R246 | F1 | J2 |
| Q214 | D2 | C1 | R250 | F2 | J1 |
| Q218 | D2 | C1 | R252 | G2 | J2 |
| Q223 | E3 | E1 | R253 | G2 | J2 |
| Q229 | E3 | E1 | R255 | G2 | D2 |
| Q241 | E1 | E1 | R261 | E3 | D2 |
| Q245 | F1 | I1 | R262 | F2 | I4 |
| Q249 | G1 | J1 | R264 | F2 | I4 |
| Q260 | F2 | D1 | R266 | F3 | I4 |
| Q265 | F2 | I4 | R268 | F2 | I4 |
| Q269 | F3 | I4 | R270 | F3 | H4 |
| | | | R272 | G3 | H5 |
| R170 | A1 | J2 | | | |
| R172 | A2 | J2 | S20 | G4 | F2 |
| R173 | A2 | J2 | S170 | B1 | J2 |
| R175 | B2 | C2 | | | |
| R176 | B2 | D2 | TP245 | G1 | J2 |
| R180 | A2 | F3 | | | |
| R182 | A3 | F3 | U98C | G3 | H5 |
| R183 | A3 | G3 | U175 | B1 | C2 |
| R185 | A3 | F3 | U200 | C3 | C1 |
| R187 | B2 | F3 | | | |
| R189 | B3 | F3 | VR233 | E2 | E1 |

*Partial A1 also shown on diagrams 1, 2, 4, 6 and 7.*

### CHASSIS MOUNTED PARTS

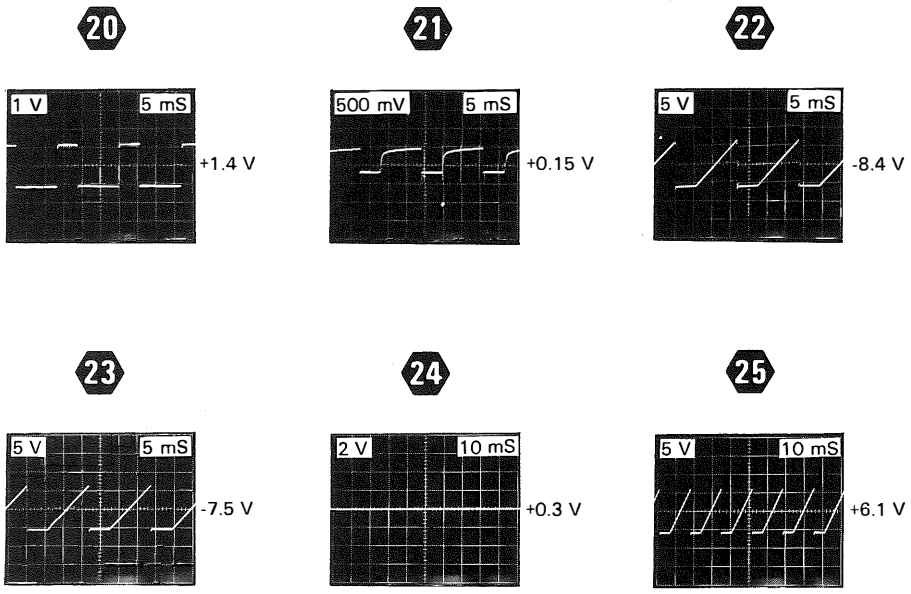
| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
|---|---|---|---|---|---|
| J18 | G2 | CHASSIS | | | |

## VOLTAGE AND WAVEFORM CONDITIONS

The 5B25N Digitizer Time Base/Ampl was installed in a Tektronix 5000 Series mainframe (Tektronix 5440 Oscilloscope). The 5B25N controls were set as follows: TIME/DIV (1 ms); SOURCE (LINE); COUPLING (AC); MODE (AUTO); DISPLAY (CH); SLOPE (+); PRETRIGGER (MIDRANGE); CAL (FULL CW).

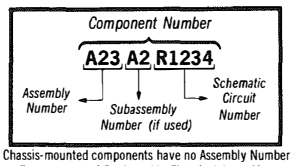
**Waveform Measurement Equipment.** The waveforms shown below were obtained using a test oscilloscope system with 10 MΩ input impedance, at least 60 MHz bandwidth and 10X probe (Tektronix 7603 Oscilloscope, 7B80 Time Base, 7A13 Differential Comparator and P6106 Probe).

**Voltage Measurement Equipment.** The voltages were taken with the above oscilloscope system or a digital multimeter with 10 MΩ input impedance (Tektronix DM 501A Option 02 Digital Multimeter installed in a TM501 Power Module).

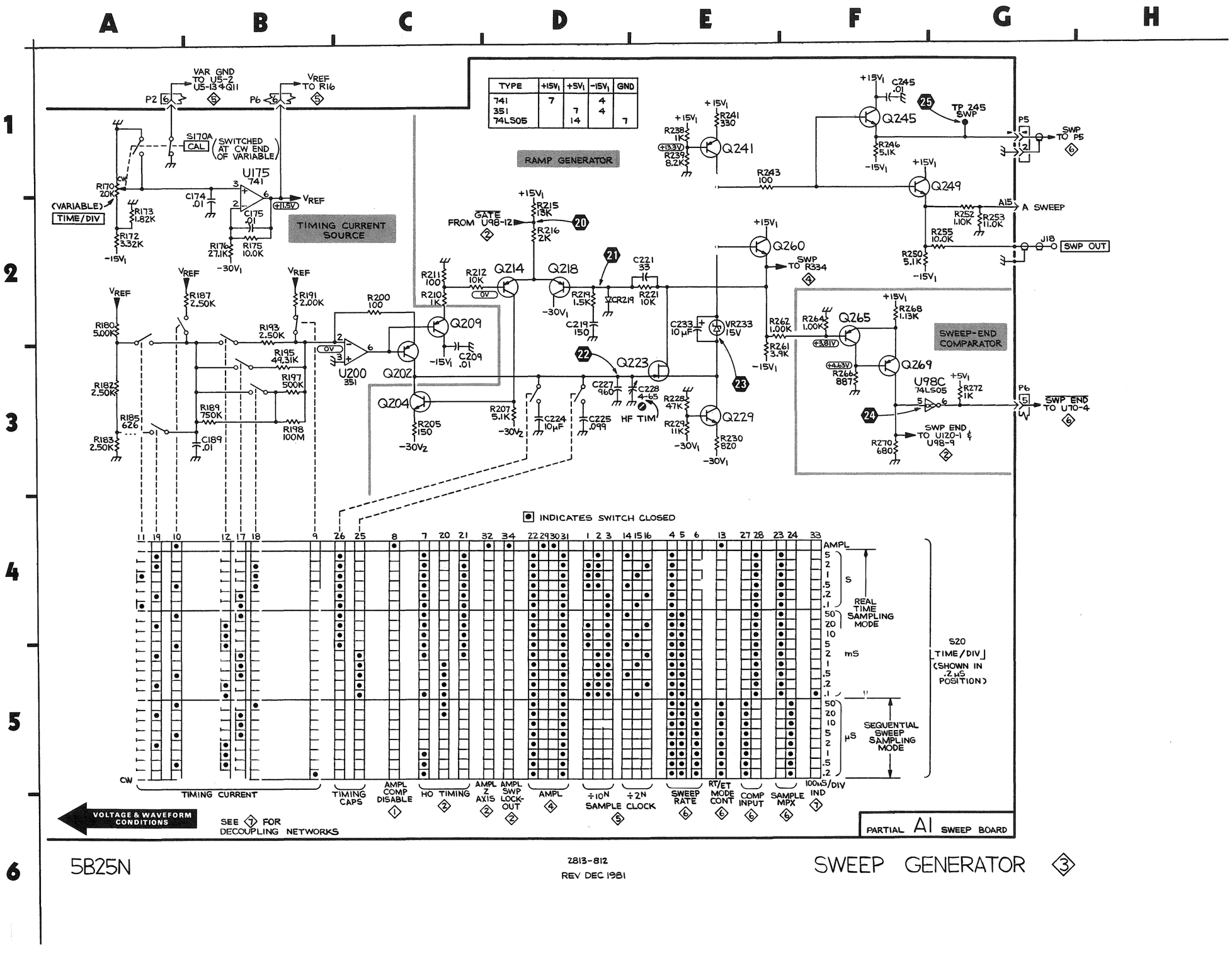



**Static Sensitive Devices**
*See Maintenance Section*

**COMPONENT NUMBER EXAMPLE**




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




5B25N

2813-812
REV DEC 1981

# SWEEP GENERATOR 3

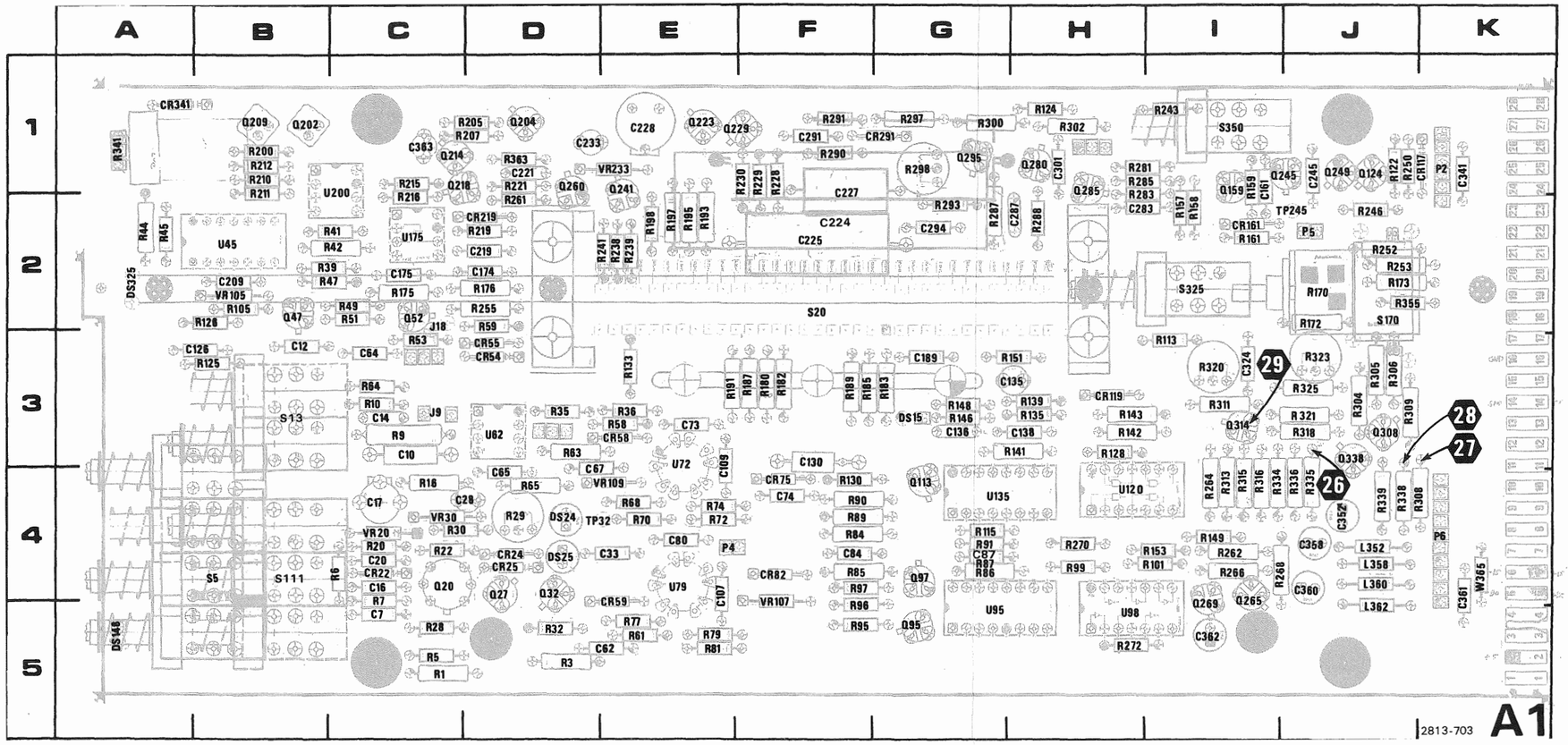
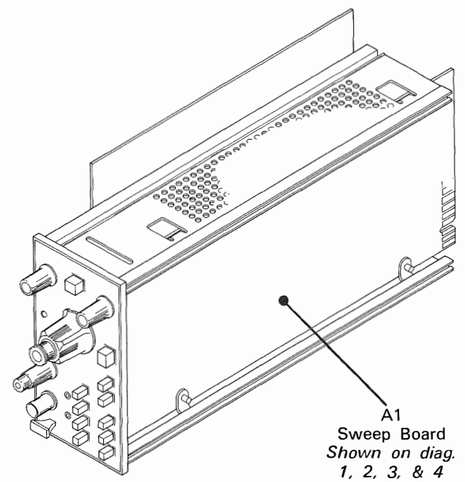
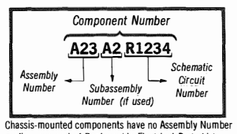



Figure 8-6. A1-Sweep circuit board assembly.




Static Sensitive Devices
*See Maintenance Section*

**COMPONENT NUMBER EXAMPLE**




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

@

## HORIZONTAL AMPLIFIER DIAGRAM 4

### ASSEMBLY A1

| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
|---|---|---|---|---|---|
| C283 | C2 | H2 | R297 | C3 | G1 |
| C287 | C3 | H2 | R298 | C4 | G1 |
| C291 | B3 | F1 | R300 | C3 | G1 |
| C294 | B3 | G2 | R302 | D3 | H1 |
| C301 | D4 | H1 | R304 | D3 | J3 |
| C324 | E4 | I3 | R305 | E3 | J3 |
| | | | R306 | E3 | J3 |
| CR291 | B3 | G1 | R308 | E3 | J4 |
| | | | R309 | E3 | J3 |
| DS325 | F4 | A2 | R311 | E3 | I3 |
| | | | R313 | D4 | I4 |
| Q280 | B3 | H1 | R315 | D4 | I4 |
| Q285 | C2 | H1 | R316 | D4 | I4 |
| Q295 | C3 | G1 | R318 | E4 | J3 |
| Q308 | E3 | J3 | R320 | E4 | I3 |
| Q314 | D4 | I3 | R321 | E4 | J3 |
| Q338 | E5 | J3 | R323 | F3 | J3 |
| | | | R325 | F4 | J3 |
| R281 | B2 | H1 | R334 | D4 | I4 |
| R283 | C3 | H1 | R335 | E4 | J4 |
| R285 | C2 | H1 | R336 | E5 | J4 |
| R287 | C3 | G2 | R338 | E5 | J4 |
| R288 | C3 | H2 | R339 | E5 | J4 |
| R290 | B3 | F1 | | | |
| R291 | B3 | F1 | S20 | F2 | F2 |
| R293 | B3 | G2 | S325 | F4 | I2 |

*Partial A1 also shown on diagrams 1, 2, 3, 6 and 7.*

### CHASSIS MOUNTED PARTS

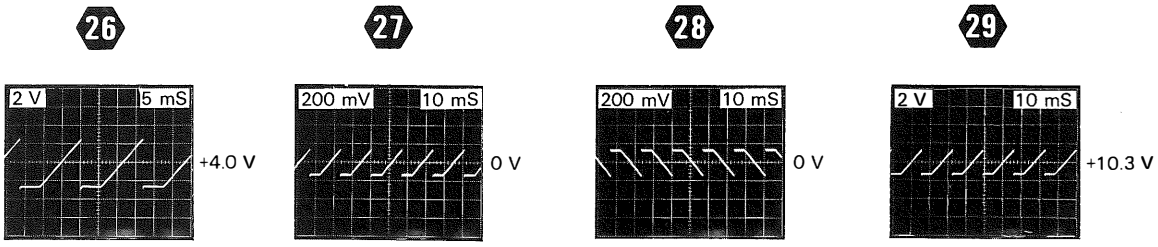
| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION | CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
|---|---|---|---|---|---|
| R23 | C4 | CHASSIS | | | |

## VOLTAGE AND WAVEFORM CONDITIONS

The 5B25N Digitizer Time Base/Ampl was installed in a Tektronix 5000 Series mainframe (Tektronix 5440 Oscilloscope). The 5B25N controls were set as follows: TIME/DIV (1 ms); SOURCE (LINE); COUPLING (AC); MODE (AUTO); DISPLAY (CH); SLOPE (+); PRETRIGGER (MIDRANGE); CAL (FULL CW).

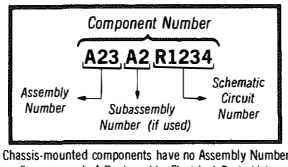
**Waveform Measurement Equipment.** The waveforms shown below were obtained using a test oscilloscope system with 10 MΩ input impedance, at least 60 MHz bandwidth and 10X probe (Tektronix 7603 Oscilloscope, 7B80 Time Base, 7A13 Differential Comparator and P6106 Probe).

**Voltage Measurement Equipment.** The voltages were taken with the above oscilloscope system or a digital multimeter with 10 MΩ input impedance (Tektronix DM 501A Option 02 Digital Multimeter installed in a TM501 Power Module).




Static Sensitive Devices
*See Maintenance Section*

**COMPONENT NUMBER EXAMPLE**

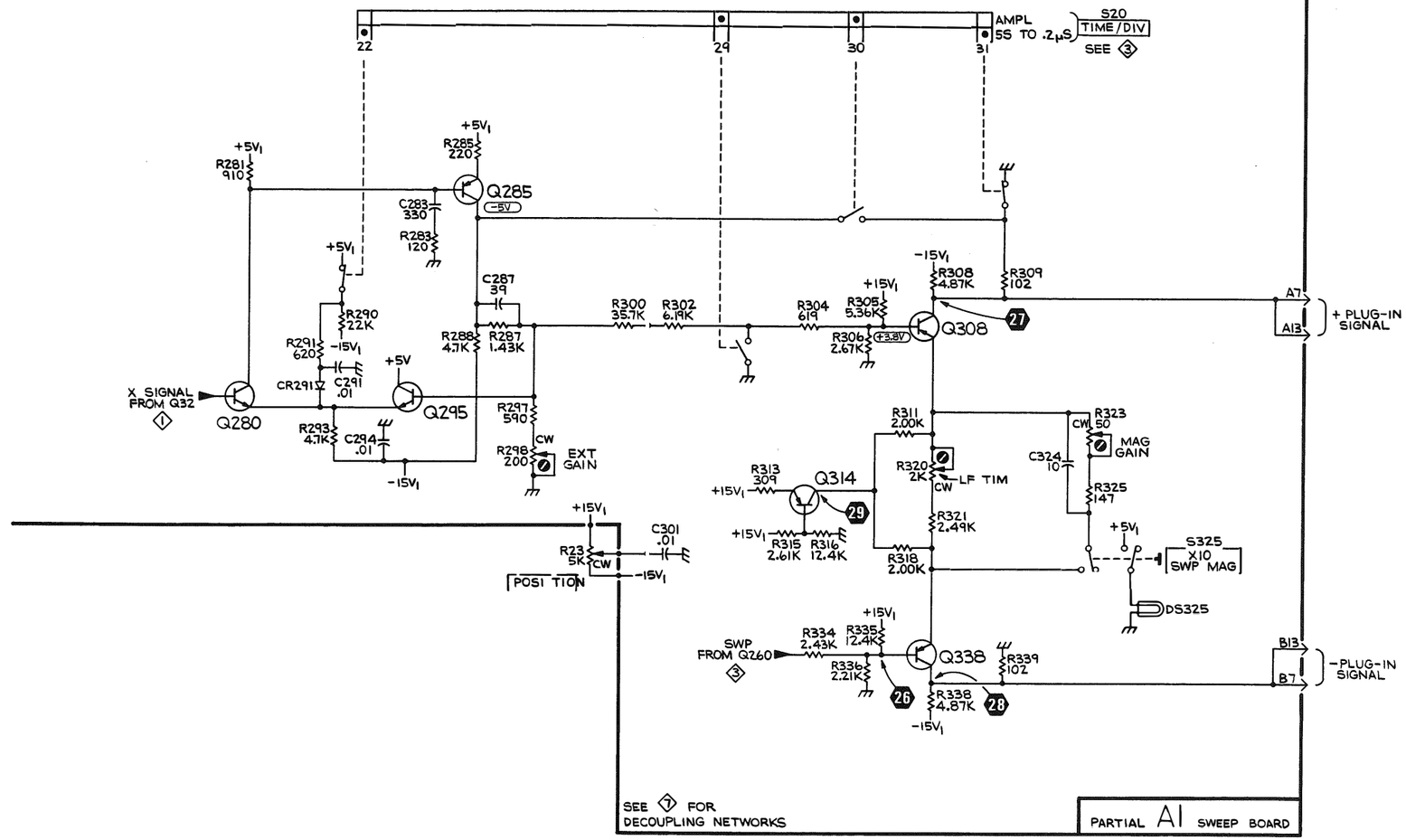



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

A B C D E F G H

1 2 3 4 5 6

VOLTAGE & WAVEFORM CONDITIONS




SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

5B25N

2813-813
@

HORIZONTAL AMPLIFIER 4

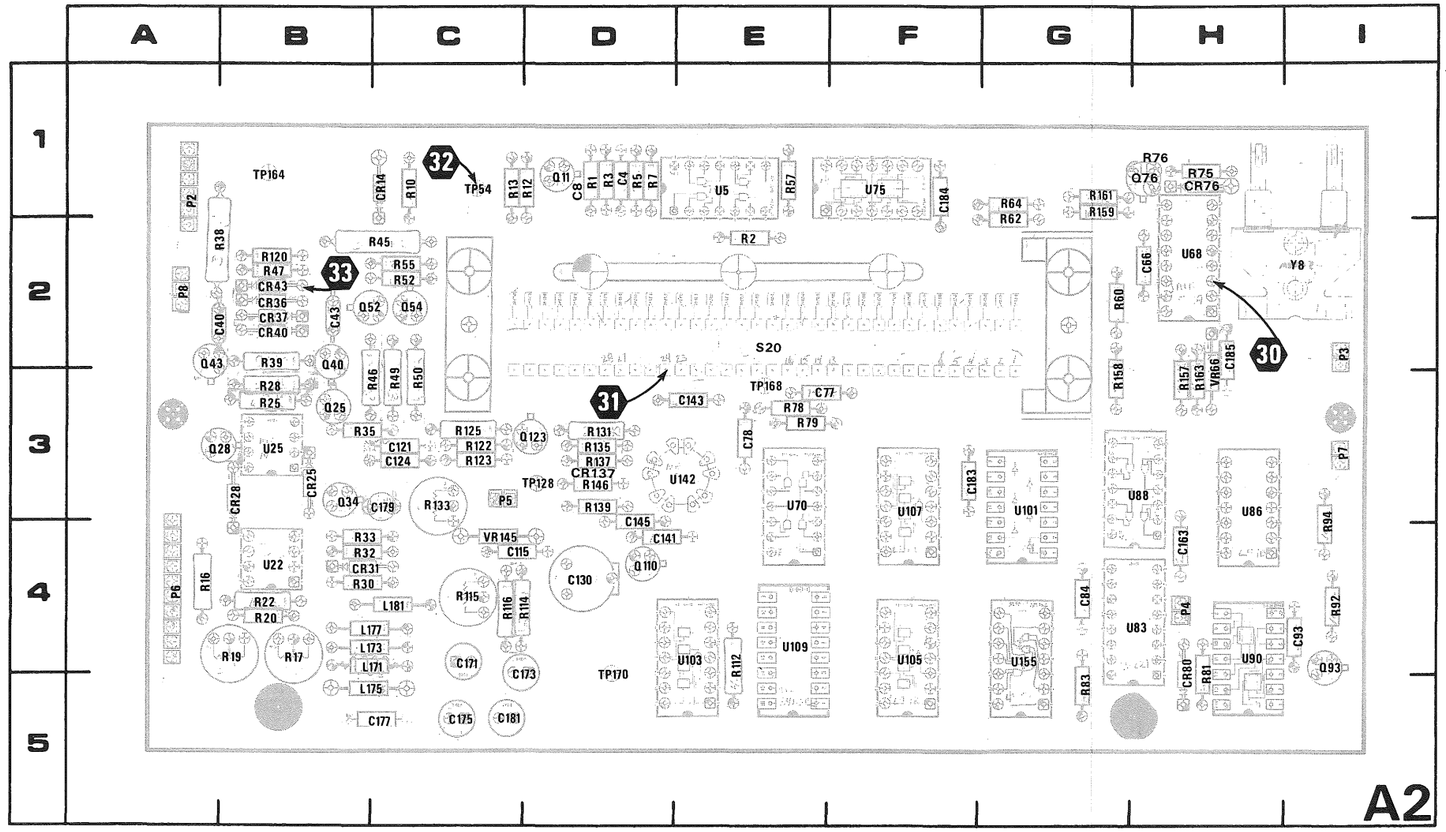
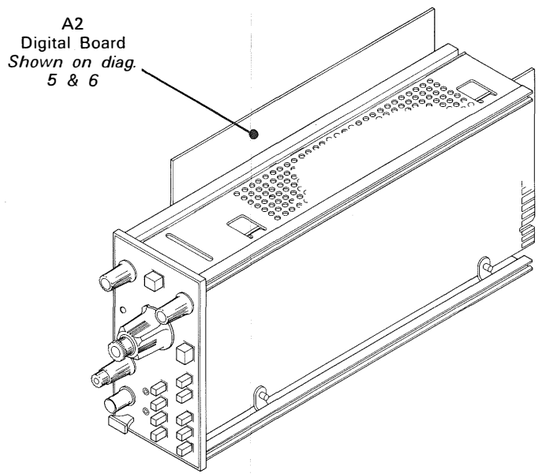


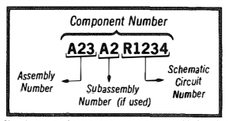

Figure 8-7. A2-Digital circuit board assembly.

2813-704A




Static Sensitive Devices
*See Maintenance Section*

**COMPONENT NUMBER EXAMPLE**




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

## CLOCK GENERATOR AND UNDERSAMPLING DIAGRAM 5

### ASSEMBLY A2

| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
|---|---|---|
| C4 | B3 | D1 |
| C8 | B3 | D1 |
| C40 | B5 | A2 |
| C43 | C5 | B2 |
| C66 | D4 | H2 |
| C84 | F4 | G4 |
| C93 | G4 | I4 |
| CR14 | B4 | C1 |
| CR25 | C4 | B3 |
| CR28 | B5 | B3 |
| CR31 | A5 | B4 |
| CR36 | B5 | B2 |
| CR37 | B5 | B2 |
| CR40 | B6 | B2 |
| CR43 | C6 | B2 |
| CR80 | E5 | H5 |
| P2 | A3 | A1 |
| P3 | G5 | I2 |
| P4 | E5 | H5 |
| P6 | A4 | A4 |
| Q11 | A4 | D1 |
| Q25 | C4 | B3 |
| Q28 | C5 | B3 |
| Q34 | A5 | B3 |
| Q40 | B6 | B2 |
| Q43 | C6 | A2 |
| Q52 | C5 | B2 |
| Q54 | D4 | C2 |
| Q93 | G5 | I4 |
| R1 | B3 | D1 |
| R3 | B3 | D1 |
| R5 | B3 | D1 |
| R7 | C3 | D1 |
| R10 | A3 | C1 |
| R12 | A4 | D1 |
| R13 | B3 | C1 |
| R16 | A4 | A4 |
| R17 | A4 | B4 |
| R19 | A4 | B4 |
| R20 | A4 | B4 |
| R22 | B4 | B4 |
| R25 | C4 | B3 |
| R28 | C5 | B3 |
| R30 | B5 | B4 |
| R32 | A5 | B4 |
| R33 | A5 | B4 |
| R35 | B5 | B3 |
| R38 | B5 | A2 |
| R39 | B5 | B2 |
| R45 | C5 | C2 |
| R46 | C5 | C3 |
| R47 | C5 | B2 |
| R49 | C5 | C3 |
| R50 | C5 | C3 |
| R52 | C4 | C2 |
| R55 | C3 | C2 |
| R57 | D3 | E1 |
| R60 | D3 | G2 |
| R62 | D3 | G1 |
| R64 | D3 | G1 |
| R81 | E5 | H5 |
| R83 | E5 | G5 |
| R92 | G4 | I4 |
| R94 | G5 | I3 |
| S20 | F1 | E2 |
| TP54 | D4 | C1 |
| U5A | C3 | E1 |
| U5C | D3 | E1 |
| U5D | B3 | E1 |
| U22 | B5 | B4 |
| U25A | C4 | B3 |
| U25B | B5 | B3 |
| U68 | D3 | H2 |
| U75A | E4 | F1 |
| U75B | E4 | F1 |
| U83A | E5 | H5 |
| U86 | F5 | H3 |
| U88A | G5 | H3 |
| U88B | E3 | H3 |
| U90A | G5 | H5 |
| VR66 | D4 | H3 |
| Y8 | B3 | I2 |

*Partial A2 also shown on diagrams 6 and 7.*

### CHASSIS MOUNTED PARTS

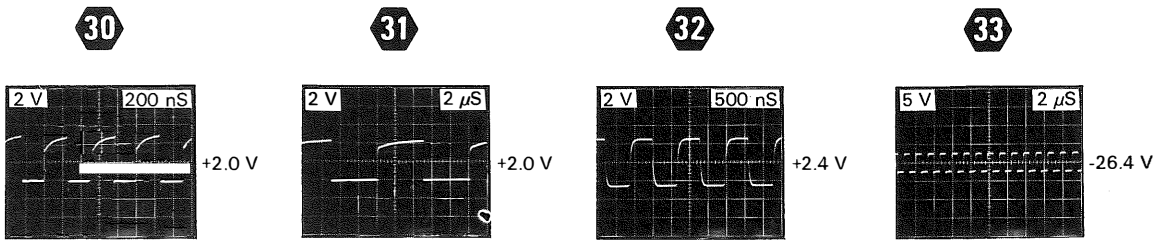
| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
|---|---|---|
| DS25 | G5 | CHASSIS |

## VOLTAGE AND WAVEFORM CONDITIONS

The 5B25N Digitizer Time Base/Ampl was installed in a Tektronix 5000 Series Mainframe (Tektronix 5440 Oscilloscope). The 5B25N controls were set as follows: TIME/DIV (1 ms); SOURCE (LINE); COUPLING (AC); MODE (AUTO); DISPLAY (CHOP); SLOPE (+); PRETRIGGER (MIDRANGE); CAL (FULL CW for 30, 31 ; FULL CCW for 32, 33 ). Voltages in VCO circuit taken with CAL (FULL CCW).

**Waveform Measurement Equipment.** The waveforms shown below were obtained using a test oscilloscope system with 10 MΩ input impedance, at least 60 MHz bandwidth and 10X probe (Tektronix 7603 Oscilloscope, 7B80 Time Base, 7A13 Differential Comparator and P6106 Probe).

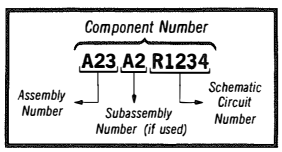
**Voltage Measurement Equipment.** The voltages were taken with the above oscilloscope system or a digital multimeter with 10 MΩ input impedance (Tektronix DM 501A Option 02 Digital Multimeter installed in a TM501 Power Module).






Static Sensitive Devices
*See Maintenance Section*

**COMPONENT NUMBER EXAMPLE**




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

| TYPE | $V_{CC}$ +5V₂ | GND | +V +15V | −V −15V | UNUSED PINS GND |
|---|---|---|---|---|---|
| 74LS00 | 14 | 7 | | | 4,5 (U5) |
| 74LS02 | 14 | 7 | | | |
| 74LS73 | 4 | 11 | | | |
| 74LS74 | 14 | 7 | | | |
| 74LS90 | 5 | 10 | | | |
| 74LS221 | 16 | 8 | | | |
| 1458 | | | 8 | 4 | |
| 741C | | | 7 | 4 | |

SEE ◇7 FOR DECOUPLING NETWORKS

VOLTAGE & WAVEFORM CONDITIONS

AMPL 5 2 1 .5 .2 .1 S; 50 20 10 5 2 1 .5 .2 .1 mS; 50 20 10 5 2 1 .5 .2 .1 µS

S20 [TIME/DIV] SEE ◇3

CW 1 2 3 14 15 16

+5V₂ 15 Vss

C8 22 Y8 2MHz R3 3.3K C4 .01 R7 3.3K R1 2.7K U5D 74LS00 R5 2.7K U5A 74LS00

VAR GND FROM S170 ◇3 P2 R10 10K +5V₂ +15V₂ R13 10K Q11 R12 10K CR14 +4.98V

CRYSTAL OSCILLATOR

VOLTAGE-CONTROLLED OSCILLATOR

VREF FROM U175-6 ◇3 P6 R16 15.00K +5V₂ VCO FAST CW R17 10K VCO SLOW −15V₂ R19 50K R20 750K +15V₂ 0V

R22 10.00K U22 741C R25 6.34K CR25 Q25 U25A 1458 −2.16V R28 6.34K CR28 Q28 U25B 1458

R32 18K R33 27K CR31 R30 10K Q34 −30V₂ R35 56K CR36 R38 3.65K C40 51 CR37 R39 845 −30V₂ CR40 Q40 −30V₂

R50 36.5K −24.4V R49 8.45K −30V₂ R52 1.5K Q52 Q54 R47 1K R45 3.65K −26.9V R46 845 −30V₂ C43 51 CR43 Q43 −30V₂

TP 54 VCO OUT +1.2V ◇32

R64 10K R62 10K R60 10K R57 4.7K +5V₂ 2₃ 2₂ 2₁ 2₀ TIME OUT

R55 2.2K U5C 74LS00 EXT INPUT ◇30

U68 COUNTER MK5009P EXT/INT CLAMP R₀ R_MAX V_GG V_DD C66 .01 VR66 4.3V −15V₂

FREQUENCY DIVIDER

U88B 74LS02 ◇31 REAL-TIME SAMPLE PULSE TO P8-2 ◇6

U75B 74LS73 U75A 74LS73

UNDERSAMPLING DETECTOR

TRIG FROM CR75, CR82 ◇1 P4 CR80 R81 1K

U83A 74LS221 C84 0.1 R83 2K

SAMPLE PULSE FROM U101-4 ◇6

U86 74LS90 R9₂ R9₁ R0₁ R0₂ C_A C_B Q_A Q_D

U88A 74LS02 MODE CONTROL FROM U101-2 ◇6 +0.17V

U90A 74LS74 C93 .01 R92 100 +0.183V Q93 R94 100 P3 D525 POSSIBLE UNDER-SAMPLING

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

PARTIAL A2 DIGITAL BOARD

5B25N

2813-814 @

# CLOCK GENERATOR & UNDERSAMPLING ◇5

◇5 Clock Generator & Undersampling | Reverse Side A2

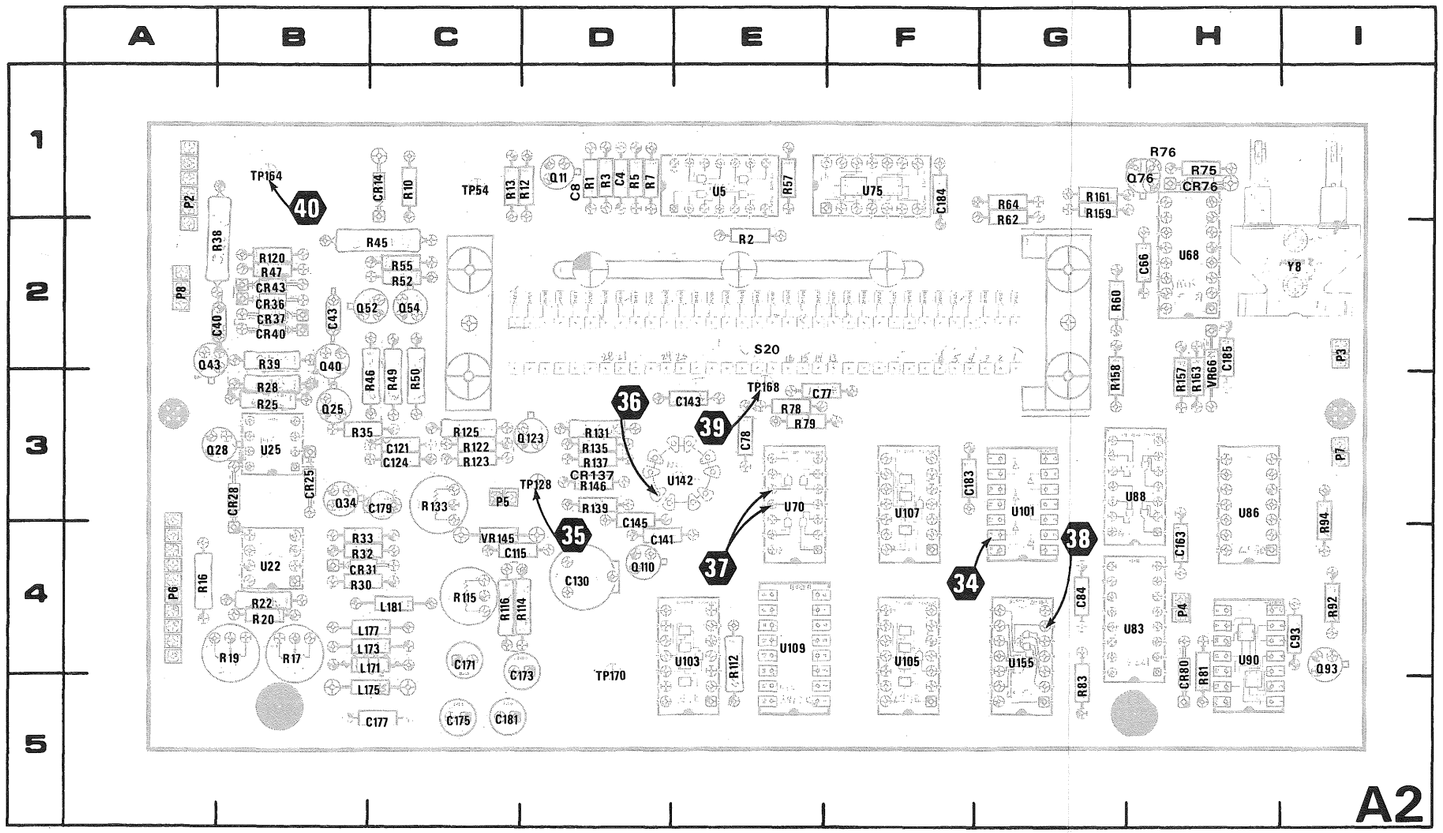
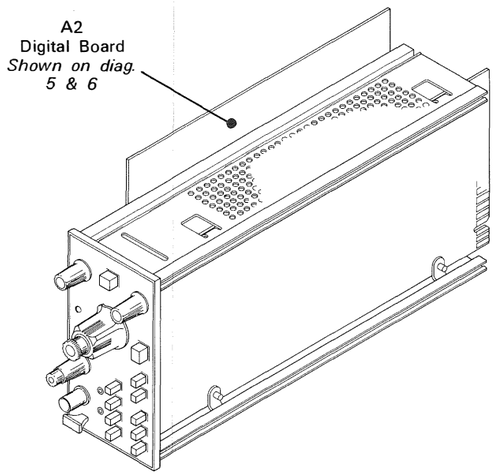


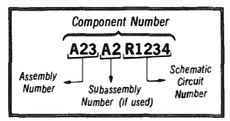

Figure 8-8. A2-Digital circuit board assembly.

2813-705A




Static Sensitive Devices
*See Maintenance Section*

**COMPONENT NUMBER EXAMPLE**




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

# LOGIC DIAGRAM 6

## ASSEMBLY A1

| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
|---|---|---|
| C341 | B5 | K1 |
| CR341 | B5 | A1 |
| P2 | B5 | K1 |
| P2 | G1 | K1 |
| R341 | B5 | A1 |

*Partial A1 also shown on diagrams 1, 2, 3, 4 and 7.*

## ASSEMBLY A2

| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
|---|---|---|
| C77 | F3 | E3 |
| C78 | E2 | E3 |
| C115 | B4 | C4 |
| C121 | C5 | C3 |
| C124 | C5 | C3 |
| C130 | D5 | D3 |
| C141 | D3 | D3 |
| C143 | E3 | E3 |
| C145 | D4 | D2 |
| C163 | G2 | H5 |
| CR76 | F4 | H1 |
| P2 | B5 | A1 |
| P2 | G1 | A1 |
| P5 | B6 | C3 |
| P6 | A2 | A4 |
| P6 | E5 | A4 |
| P7 | G5 | I3 |
| P8 | F3 | A2 |
| Q76 | G4 | H1 |
| Q110 | C4 | D3 |
| Q123 | C5 | D2 |
| R75 | G5 | H1 |
| R76 | G4 | H1 |
| R78 | F2 | E3 |
| R79 | F3 | E3 |
| R112 | C4 | E4 |
| R114 | B4 | C4 |
| R115 | B4 | C4 |
| R116 | B5 | C4 |
| R120 | C5 | B2 |
| R122 | C5 | C3 |
| R123 | C5 | C3 |
| R125 | C5 | C3 |
| R131 | D6 | D2 |
| R133 | D5 | C3 |
| R135 | D5 | D2 |
| R137 | D4 | D2 |
| R139 | D4 | D2 |
| R146 | E4 | D2 |
| R157 | F1 | H3 |
| R158 | E1 | G3 |
| R159 | F1 | G1 |
| R161 | F1 | G1 |
| R163 | G2 | H3 |
| S20 | G1 | E2 |
| TP128 | C6 | D2 |
| TP164 | G2 | B1 |
| TP168 | G2 | E3 |
| U5B | F4 | E1 |
| U70B | E3 | E3 |
| U70D | E3 | E3 |
| U83B | G2 | H5 |
| U88C | G2 | H3 |
| U88D | E2 | H3 |
| U90B | G2 | H5 |
| U101A | F2 | G3 |
| U101B | G3 | G3 |
| U101C | E3 | G3 |
| U101F | A3 | G3 |
| U103 | B4 | E4 |
| U105 | B3 | F4 |
| U107 | B3 | F3 |
| U109 | C4 | E4 |
| U142 | D3 | E3 |
| U155 | F2 | G4 |
| VR145 | D4 | C4 |

*Partial A2 also shown on diagrams 5 and 7.*

## CHASSIS MOUNTED PARTS

| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
|---|---|---|
| J29 | G5 | CHASSIS |
| S29 | F3 | CHASSIS |

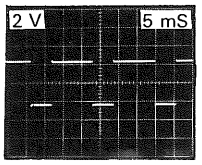
## VOLTAGE AND WAVEFORM CONDITIONS

The 5B25N Digitizer Time Base/Ampl was installed in a Tektronix 5000 Series mainframe (Tektronix 5440 Oscilloscope). The 5B25N controls were set as follows: TIME/DIV (1 ms); SOURCE (LINE); COUPLING (AC); MODE (AUTO); DISPLAY (CH); SLOPE (+); PRETRIGGER (MIDRANGE); CAL (FULL CW).

**Waveform Measurement Equipment.** The waveforms shown below were obtained using a test oscilloscope system with 10 MΩ input impedance, at least 60 MHz bandwidth and 10X probe (Tektronix 7603 Oscilloscope, 7B80 Time Base, 7A13 Differential Comparator and P6106 Probe).

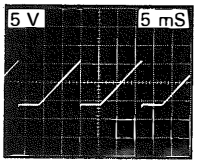
**Voltage Measurement Equipment.** The voltages were taken with the above oscilloscope system or a digital multimeter with 10 MΩ input impedance (Tektronix DM 501A Option 02 Digital Multimeter installed in a TM501 Power Module).

**34**



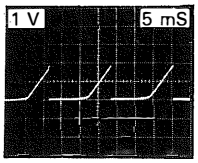

+2.6 V

**35**



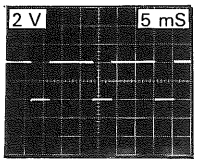

+6.0 V

**36**



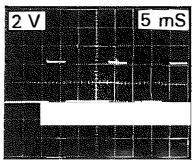

+0.7 V

**37**



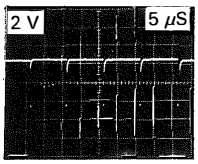

+2.3 V

**38**



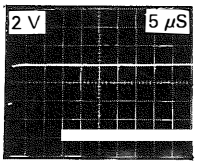

+2.3 V

**39**




+2.6 V

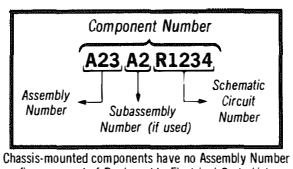
**40**




+2.4 V

Static Sensitive Devices
*See Maintenance Section*

**COMPONENT NUMBER EXAMPLE**




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

| TYPE | Vcc +5V₂ | GND | UNUSED PINS-GND |
|---|---|---|---|
| 74LS00 | 14 | 7 | 1,2,4,5 |
| 74LS04 | 14 | 7 | 9,11 |
| 74LS51 | 14 | 7 | |
| 74LS93 | 5 | 10 | |
| 74LS221 | 16 | 8 | |

SEE ⑦ FOR DECOUPLING NETWORKS

AMPL S mS µS — S20 TIME/DIV — SEE ③

PARTIAL A1 SWEEP BOARD

P2 P2 B24 SWEEP RATE ⑦

R161 20K, R159 100K, R157 43K, -15V₂

+5V₂ R158 4.7K -15V₂ -15V₂

U101A 74LS04 — MODE CONTROL ⑤ TO U88-2

U88D 74LS02

U90B 74LS74 — +5V₂ R163 5.6K C163 270 — LOAD STOP TP164 ⑩ — LOAD STOP TO B11 THRU P2-4 ⑦

U83B 74LS221

U155A 74LS51

C78 .01, R78 1K, R79 1K, C77 150

U88C 74LS02 — SAMPLE PULSE TP168 ⑨ — SAMPLE PULSE TO A11 THRU P2-2 ⑦

U101B 74LS04 — SAMPLE PULSE TO U86-14 ⑤

U155B 74LS51

GATE FROM U120-6 ②

P6 ⑧ ⑭ — U101F 74LS04

U107 74LS93 — +5V₂ 14 Vcc

U105 74LS93

U103 74LS93 — +5V

U109 3410C — R112 4.99K, R114 22.6K, C115 .01, R115 5K, R116 47.5K -30V, SAMPLE PS, VREF, VEE -15V₃, GND

C141 10 — U70D 74LS00 ⑦ — U70B 74LS00 — U101C 74LS04

P8 ① ② ③ — EXT CLK — SAMPLE CLK SOURCE — S170B

Q110 — $I_{OUT}$ — CR137 — R137 1K ⑥

+5V₂ C143 .01, C145 .01, VR145 7.5V, -15V₃, R139 750, R146 56K

U142 529 — REAL-TIME SAMPLE PULSE FROM S20-14,15,16 ⑤

U5B 74L500 — +5V₂ R76 1K — CR76 — Q76 — R75 1K

PARTIAL A2 DIGITAL BOARD — P7 — J29 — CLK IN

P6 ⑤ — SWP END FROM U98-6 ③

+15V₂ C124 .01, R123 75K — R120 1K, R122 100, C121 .01 — Q123 (-7V) — R125 3.16K

+15V₂ R133 25K CW — R135 51K — -15V₃ — SAMPLE ZERO

PRETRIGGER — C341 0.1 — R341 20K CW — CR341 — -15V₁ — PARTIAL A1 SWEEP BRD

P2 P2 — P5 ⑤ ② — SWP FROM Q245 THRU P5 ③

SWP TP128 ⑪ — C130 5.5-65 — R131 2.80K — HIGH RATE COMP

VOLTAGE & WAVEFORM CONDITIONS

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

5B25N

2813-815

LOGIC ⑥

⑥ Logic

## INTERCONNECTIONS DIAGRAM 7

### ASSEMBLY A1

| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
|---|---|---|
| C352 | B5 | J4 |
| C358 | F4 | J4 |
| C360 | F5 | J4 |
| C361 | F5 | K4 |
| C362 | F5 | I5 |
| C363 | F5 | C1 |
| L352 | B5 | J4 |
| L358 | F4 | J4 |
| L360 | F5 | J4 |
| L362 | F5 | J5 |
| P2 | E3 | K1 |
| P4 | E6 | E4 |
| P5 | C4 | J2 |
| P6 | C6 | K4 |
| P6 | E5 | K4 |
| R355 | D2 | J2 |
| R363 | F5 | D1 |
| S20 | D3 | F2 |
| S350 | B2 | I1 |
| W365 | G4 | K4 |

*Partial A1 also shown on diagrams 1, 2, 3, 4 and 6.*

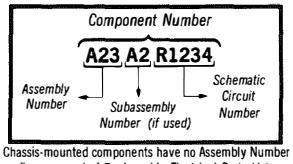
### ASSEMBLY A2

| CIRCUIT NUMBER | SCHEM LOCATION | BOARD LOCATION |
|---|---|---|
| C171 | D5 | C4 |
| C173 | E4 | C4 |
| C175 | E4 | C5 |
| C177 | E5 | C5 |
| C179 | E5 | C3 |
| C181 | E5 | C5 |
| C183 | E5 | F3 |
| C184 | D5 | F1 |
| C185 | D5 | H2 |
| L171 | C4 | B4 |
| L173 | E4 | B4 |
| L175 | E5 | B5 |
| L177 | E5 | B4 |
| L181 | E5 | C4 |
| P2 | E3 | A1 |
| P4 | E6 | H5 |
| P5 | C4 | C3 |
| P6 | C6 | A4 |
| P6 | E5 | A4 |
| TP170 | C6 | D3 |

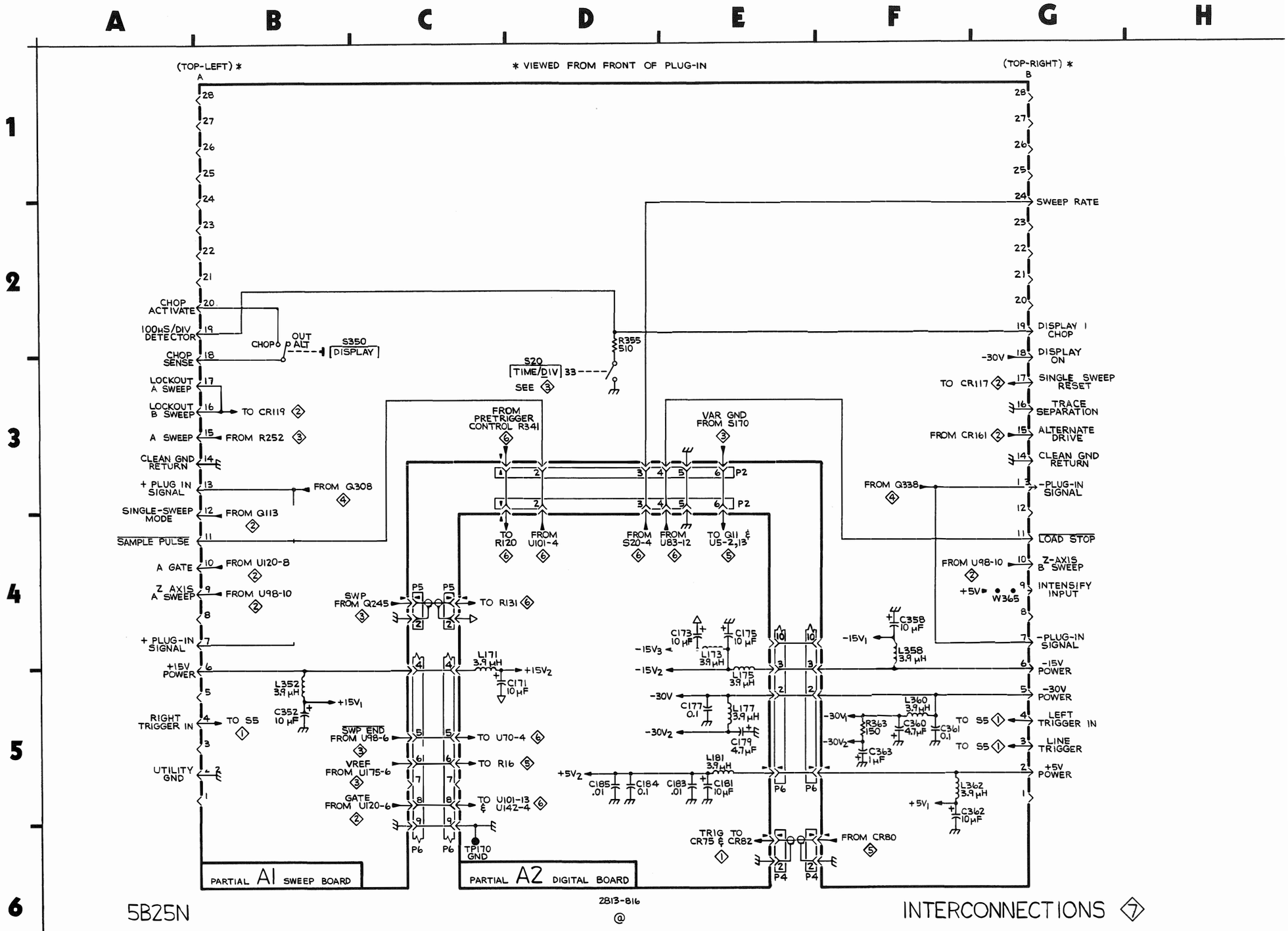
*Partial A2 also shown on diagrams 5 and 6.*

**Static Sensitive Devices**
*See Maintenance Section*

**COMPONENT NUMBER EXAMPLE**




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

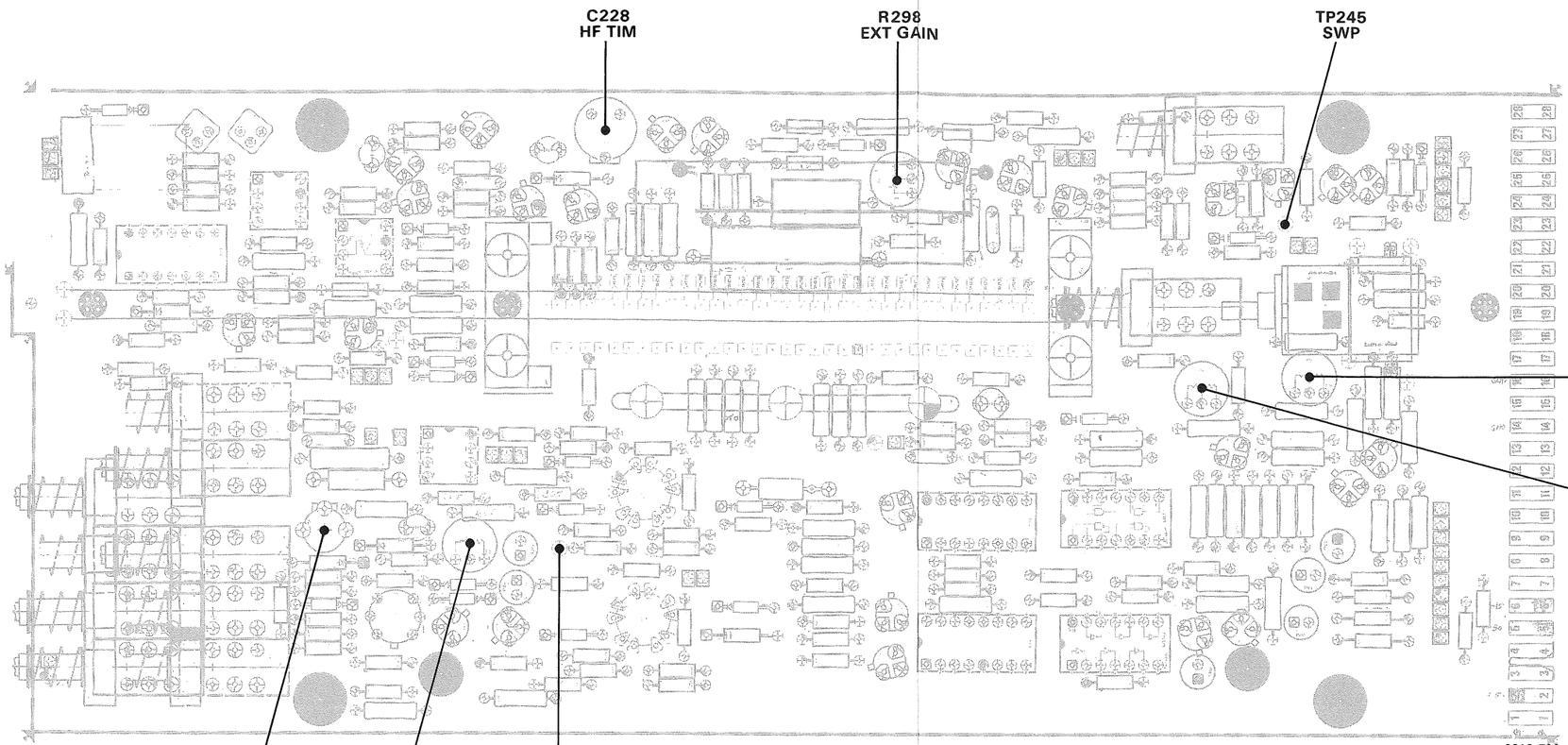



2B13-816

@

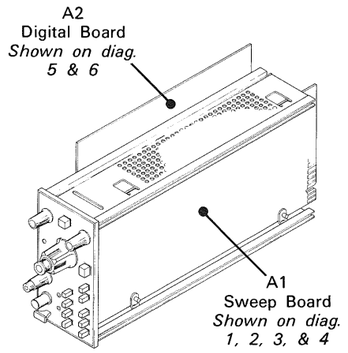
5B25N

INTERCONNECTIONS 7




SWEEP BOARD

**A1**



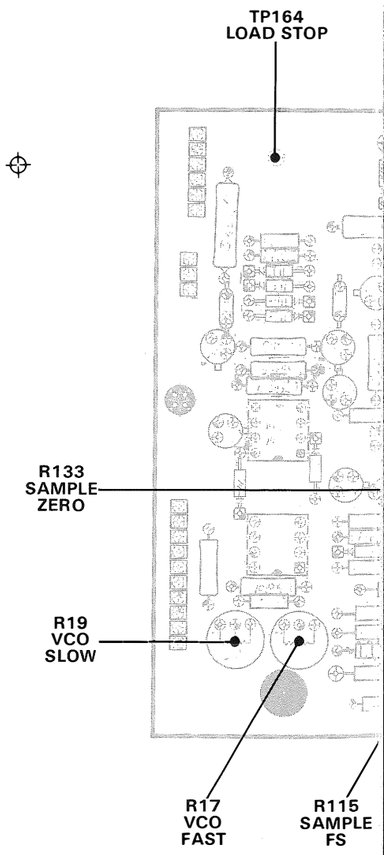
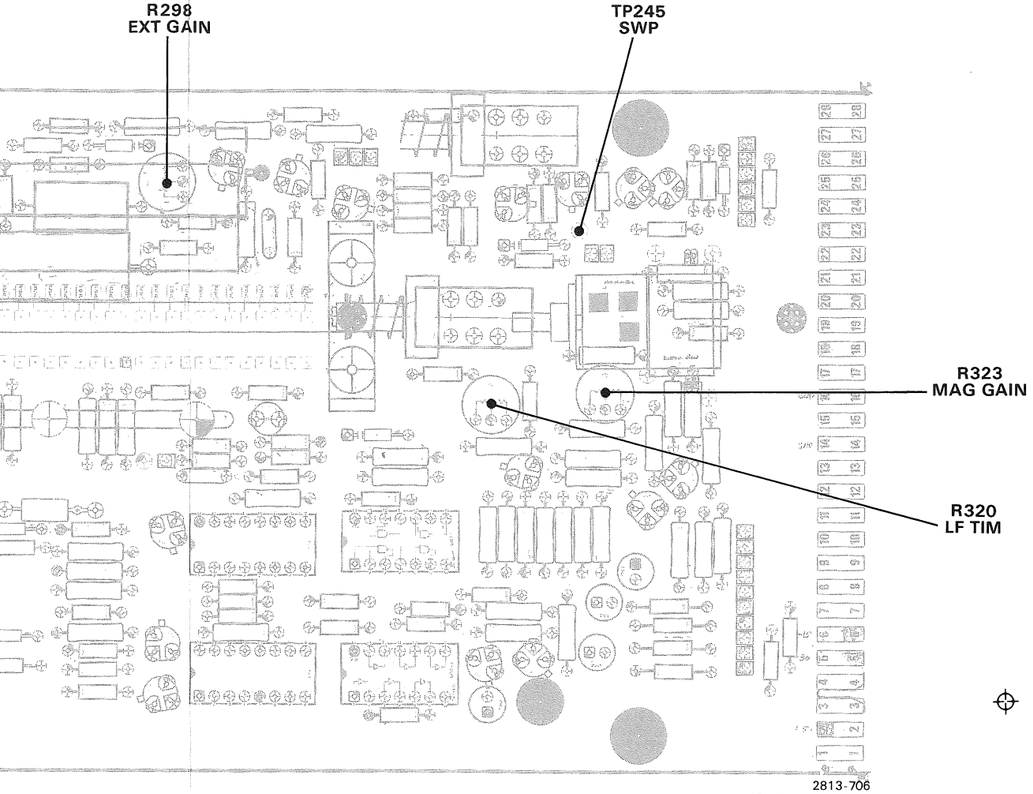
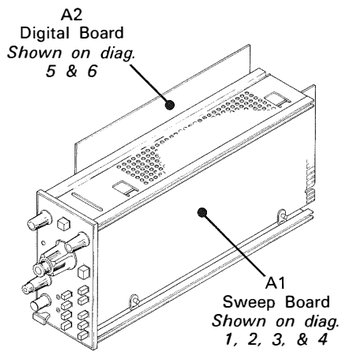



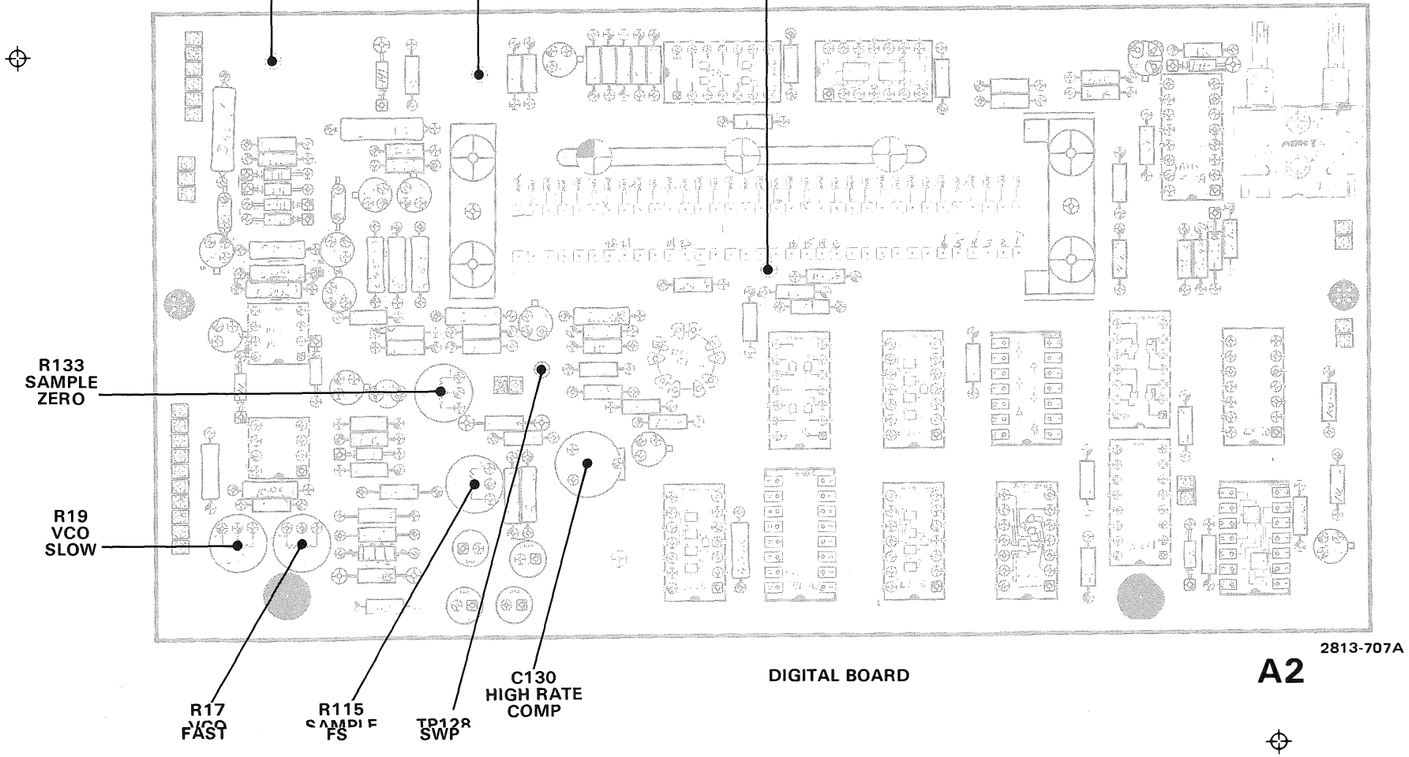

**Figure 8-9. Test point and adjustment locations.**




SWEEP BOARD

A1




DIGITAL BOARD

A2

**Figure 8-9. Test point and adjustment locations.**

REV DEC 1981

# 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

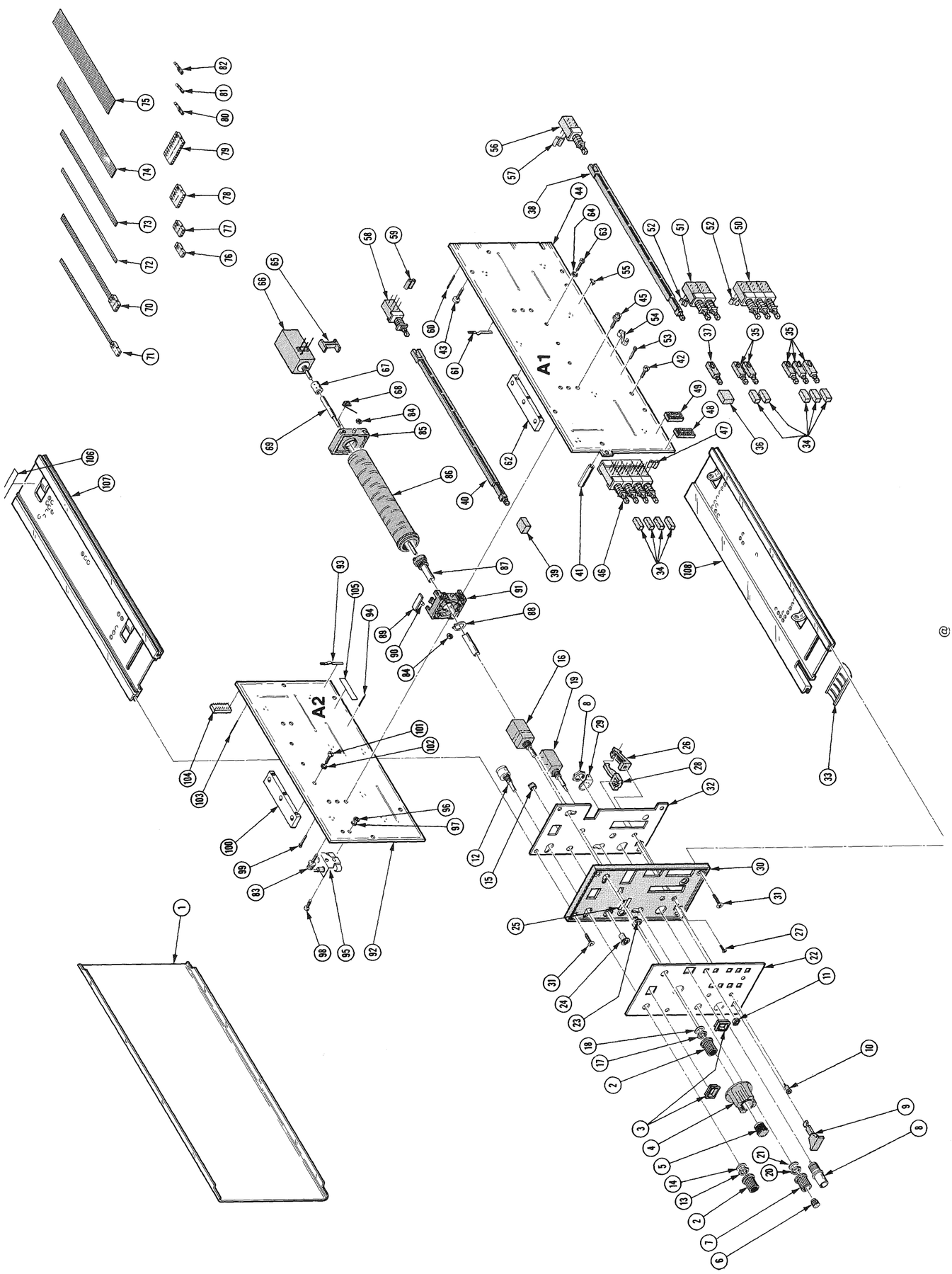
| Mfr. Code | Manufacturer | Address | City, State, Zip |
|---|---|---|---|
| 000BK | STAUFFER SUPPLY | 105 SE TAYLOR | PORTLAND, OR 97214 |
| 000CY | NORTHWEST FASTENER SALES, INC. | 7923 SW CIRRUS DRIVE | BEAVERTON, OR 97005 |
| 08261 | SPECTRA-STRIP CORP. | 7100 LAMPSON AVE. | GARDEN GROVE, CA 92642 |
| 22526 | BERG ELECTRONICS, INC. | YOUK EXPRESSWAY | NEW CUMBERLAND, PA 17070 |
| 45722 | USM CORP., PARKER-KALON FASTENER DIV. | | CAMPBELLSVILLE, KY 42718 |
| 71159 | BRISTOL SOCKET SCREW, DIV. OF AMERICAN CHAIN AND CABLE CO., INC. | P O BOX 2244, 40 BRISTOL ST. | WATERBURY, CT 06720 |
| 71279 | CAMBRIDGE THERMIONIC CORP. | 445 CONCORD AVE. | CAMBRIDGE, MA 02138 |
| 71785 | TRW, CINCH CONNECTORS | 1501 MORSE AVENUE | ELK GROVE VILLAGE, IL 60007 |
| 73743 | FISCHER SPECIAL MFG. CO. | 446 MORGAN ST. | CINCINNATI, OH 45206 |
| 73803 | TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV. | 34 FOREST STREET | ATTLEBORO, MA 02703 |
| 74445 | HOLO-KROME CO. | 31 BROOK ST. WEST | HARTFORD, CT 06110 |
| 78189 | ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION | ST. CHARLES ROAD | ELGIN, IL 60120 |
| 79136 | WALDES, KOHINOOR, INC. | 47-16 AUSTEL PLACE | LONG ISLAND CITY, NY 11101 |
| 79807 | WROUGHT WASHER MFG. CO. | 2100 S. O BAY ST. | MILWAUKEE, WI 53207 |
| 80009 | TEKTRONIX, INC. | P O BOX 500 | BEAVERTON, OR 97077 |
| 83385 | CENTRAL SCREW CO. | 2530 CRESCENT DR. | BROADVIEW, IL 60153 |
| 87308 | N. L. INDUSTRIES, INC., SOUTHERN SCREW DIV. | P. O. BOX 1360 | STATESVILLE, NC 28677 |
| 91506 | AUGAT, INC. | 33 PERRY AVE. | ATTLEBORO, MA 02703 |
| 93907 | TEXTRON INC. CAMCAR DIV | 600 18TH AVE | ROCKFORD, IL 61101 |

| 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 | 337-1399-00 | | | 2 | | SHLD,ELECTRICAL:SIDE | 80009 | 337-1399-00 |
| -2 | 366-1189-00 | | | 2 | | KNOB:GRAY | 80009 | 366-1189-00 |
| | 213-0246-00 | | | 2 | | . SETSCREW:5-40 X 0.093 ITL BK OXD,HEX SKT | 71159 | OBD |
| -3 | 426-0681-00 | | | 2 | | FR,PUSH BUTTON:GRAY PLASTIC | 80009 | 426-0681-00 |
| -4 | 366-1103-00 | | | 1 | | KNOB:GRAY | 80009 | 366-1103-00 |
| | 213-0153-00 | | | 2 | | . SETSCREW:5-40 X 0.125,STL BK OXD,HEX SKT | 000CY | OBD |
| -5 | 366-1405-00 | | | 1 | | KNOB:GRAY | 80009 | 366-1405-00 |
| | 213-0048-00 | | | 1 | | . SETSCREW:4-40 X 0.125 INCH,HEX SOC STL | 74445 | OBD |
| -6 | 366-1391-02 | | | 1 | | KNOB:GY,0.081 ID,0.28 OD,0.32 L | 80009 | 366-1391-02 |
| | 213-0075-00 | | | 1 | | . SETSCREW:4-40 X 0.094,STL BK OXD,HEX SKT | 000BK | OBD |
| -7 | 366-1077-00 | | | 1 | | KNOB:GRAY | 80009 | 366-1077-00 |
| | 213-0246-00 | | | 1 | | . SETSCREW:5-40 X 0.093 ITL BK OXD,HEX SKT | 71159 | OBD |
| -8 | 131-0955-01 | | | 1 | | CONN,RCPT,ELEC:BNC,FEMALE,MODIFIED | 80009 | 131-0955-01 |
| -9 | 366-1690-00 | | | 1 | | KNOB:SIL GY,0.53 X0.23 X 1.059 | 80009 | 366-1690-00 |
| -10 | 136-0387-00 | | | 2 | | JACK,TIP:GRAY | 71279 | 450-4352-01-0318 |
| -11 | 426-1072-00 | | | 9 | | FRAME,PUSH BTN:PLASTIC | 80009 | 426-1072-00 |
| -12 | ----- ----- | | | 1 | | RES.,VAR:(SEE R23 REPL) | | |
| | | | | | | (ATTACHING PARTS) | | |
| -13 | 210-0583-00 | | | 1 | | NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS | 73743 | 2X20317-402 |
| -14 | 210-0940-00 | | | 1 | | WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL | 79807 | OBD |
| | | | | | | - - - * - - - | | |
| -15 | 200-0935-00 | | | 2 | | BASE,LAMPHOLDER:0.29 OD X 0.19 CASE | 80009 | 200-0935-00 |
| -16 | ----- ----- | | | 1 | | RES.,VAR:(SEE R341 REPL) | | |
| | | | | | | (ATTACHING PARTS) | | |
| -17 | 210-0583-00 | | | 1 | | NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS | 73743 | 2X20317-402 |
| -18 | 210-0940-00 | | | 1 | | WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL | 79807 | OBD |
| | | | | | | - - - * - - - | | |
| -19 | ----- ----- | | | 1 | | RES.,VAR:(SEE R11 REPL) | | |
| | | | | | | (ATTACHING PARTS) | | |
| -20 | 210-0583-00 | | | 1 | | NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS | 73743 | 2X20317-402 |
| -21 | 210-0940-00 | | | 1 | | WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL | 79807 | OBD |
| | | | | | | - - - * - - - | | |
| -22 | 333-2519-00 | | | 1 | | PANEL,FRONT: | 80009 | 333-2519-00 |
| -23 | 358-0216-00 | | | 1 | | BUSHING,PLASTIC:0.257 ID X 0.412 INCH OD | 80009 | 358-0216-00 |
| -24 | 352-0157-00 | | | 2 | | LAMPHOLDER:WHITE PLASTIC | 80009 | 352-0157-00 |
| -25 | 131-1075-00 | | | 1 | | CONTACT,ELEC:GROUNDING,CU BE HEAT TRTD | 80009 | 131-1075-00 |
| -26 | 105-0719-00 | | | 1 | | LATCH,RETAINING:PLUG-IN | 80009 | 105-0719-00 |
| | | | | | | (ATTACHING PARTS) | | |
| -27 | 213-0254-00 | | | 1 | | SCREW,TPG,TF:2-32 X 0.250,100 DEG,FLH | 45722 | OBD |
| | | | | | | - - - * - - - | | |
| -28 | 105-0718-01 | | | 1 | | BAR,LATCH RLSE: | 80009 | 105-0718-01 |
| -29 | 210-0255-00 | | | 1 | | TERMINAL,LUG:0.391" ID INT TOOTH | 80009 | 210-0255-00 |
| -30 | 386-4094-00 | | | 1 | | SUBPANEL,FRONT: | 80009 | 386-4094-00 |
| | | | | | | (ATTACHING PARTS) | | |
| -31 | 213-0229-00 | | | 4 | | SCR,TPG,THD FOR:6-20 X0.375"100 DEG,FLH STL | 93907 | OBD |
| | | | | | | - - - * - - - | | |
| -32 | 337-2611-00 | | | 1 | | SHIELD,ELEC:FRONT SUBPANEL | 80009 | 337-2611-00 |
| -33 | 131-1372-01 | | | 2 | | CONTACT,ELEC:PLUG-IN GND,CU BE BRT DIP | 80009 | 131-1372-01 |
| -34 | 366-1559-00 | | | 9 | | PUSH BUTTON:SIL GY,0.18 SQ X 0.43 | 80009 | 366-1559-00 |
| -35 | 384-1136-00 | | | 5 | | EXTENSION SHAFT:0.95 INCH LONG | 80009 | 384-1136-00 |
| -36 | 366-1776-00 | | | 1 | | PUSH BUTTON:TRANSLUCENT | 80009 | 366-1776-00 |
| -37 | 384-1136-01 | | | 1 | | EXTENSION SHAFT:0.95 LONG X 0.13 SQ,PLASTIC | 80009 | 384-1136-01 |
| -38 | 384-1059-00 | | | 1 | | EXTENSION SHAFT:6.58 INCH LONG | 80009 | 384-1059-00 |
| -39 | 366-1257-31 | | | 1 | | PUSH BUTTON:SIL GRAY,CHOP | 80009 | 366-1257-31 |
| -40 | 384-1060-00 | | | 1 | | EXTENSION SHAFT:7.831 INCH LONG | 80009 | 384-1060-00 |
| -41 | 129-0570-00 | | | 2 | | POST,ELEC-MECH:0.188 HEX X 0.976"LONG,BRS | 80009 | 129-0570-00 |
| | | | | | | (ATTACHING PARTS) | | |
| -42 | 211-0008-00 | | | 4 | | SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL | 83385 | OBD |
| | | | | | | - - - * - - - | | |
| | 672-0774-00 | | | 1 | | CKT BOARD ASSY: | | |
| | | | | | | (ATTACHING PARTS) | | |
| -43 | 213-0146-00 | | | 4 | | SCR,TPG,THD FOR:6-20 X 0.313 INCH,PNH STL | 83385 | OBD |
| | | | | | | - - - * - - - | | |
| | ----- ----- | | | - | | CKT BOARD ASSY INCLUDES: | | |
| -44 | ----- ----- | | | 1 | | . CKT BOARD ASSY:SWEEP(SEE A1 REPL) | | |
| | | | | | | (ATTACHING PARTS) | | |
| -45 | 211-0116-00 | | | 4 | | . SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS | 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 |
|---|---|---|---|---|---|---|---|---|
| 1- | ----- ----- | | | - | | . CKT BOARD ASSY INCLUDES: | | |
| -46 | ----- ----- | | | 1 | | . . SWITCH,PUSH:(SEE S5 REPL) | | |
| -47 | 361-0384-00 | | | 4 | | . . SPACER,PB SW:0.133 INCH LONG | 80009 | 361-0384-00 |
| -48 | 136-0260-02 | | | 2 | | . . SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CLE | 71785 | 133-51-92-008 |
| -49 | 136-0269-02 | | | 1 | | . . SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CLE | 73803 | CS9002-14 |
| -50 | ----- ----- | | | 1 | | . . SWITCH,PUSH:(SEE S11 REPL) | | |
| -51 | ----- ----- | | | 1 | | . . SWITCH,PUSH:(SEE S13 REPL) | | |
| -52 | 361-0382-00 | | | 8 | | . . SPACER,PB SW:BROWN,0.275 INCH LONG | 80009 | 361-0382-00 |
| -53 | 214-0579-00 | | | 2 | | . . TERM,TEST POINT:BRS CD PL | 80009 | 214-0579-00 |
| -54 | 200-1167-00 | | | 1 | | . . COVER,XSTR:TEMP STAB FOR 2 TO-18 CS STYLE | 80009 | 200-1167-00 |
| -55 | 136-0350-00 | | | 2 | | . . SOCKET,PLUG-IN:3 PIN,LOW PROFILE | 80009 | 136-0350-00 |
| -56 | ----- ----- | | | 1 | | . . SWITCH,PUSH:(SEE S325 REPL) | | |
| -57 | 361-0382-00 | | | 2 | | . . SPACER,PB SW:BROWN,0.275 INCH LONG | 80009 | 361-0382-00 |
| -58 | ----- ----- | | | 1 | | . . SWITCH,PUSH:(SEE S350 REPL) | | |
| -59 | 361-0383-00 | | | 2 | | . . SPACER,PB SW:CHARCOAL,0.33 INCH LONG | 80009 | 361-0383-00 |
| -60 | 131-0608-00 | | | 20 | | . . TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD | 22526 | 47357 |
| -61 | 131-0604-00 | | | 20 | | . . CONTACT,ELEC:CKT BD SW,SPR,CU BE | 80009 | 131-0604-00 |
| -62 | 337-1418-02 | | | 1 | | . . SHIELD,ELEC:CIRCUIT BOARD | 80009 | 337-1418-02 |
| | | | | | | (ATTACHING PARTS) | | |
| -63 | 211-0001-00 | | | 3 | | . . SCREW,MACHINE:2-56 X 0.25 INCH,PNH STL | 87308 | OBD |
| -64 | 210-0001-00 | | | 3 | | . . WASHER,LOCK:INTL,0.092 ID X 0.18"OD,STL | 78189 | 1202-00-00-0541C |
| | | | | | | - - - * - - - | | |
| -65 | 361-0515-00 | | | 1 | | . . SPACER,SWITCH:PLASTIC | 80009 | 361-0515-00 |
| -66 | ----- ----- | | | 1 | | . . RES.,VAR:(SEE R170/S170A,B REPL) | | |
| -67 | 376-0029-00 | | | 1 | | . . CPLG,SHAFT,RGD:0.128 ID X 0.312 OD X 0.5"L | 80009 | 376-0029-00 |
| -68 | 131-2468-00 | | | 1 | | . . CONTACT,ELEC:GROUNDING | 80009 | 131-2468-00 |
| -69 | 384-0348-01 | | | 1 | | . . EXTENSION SHAFT:0.125 DIA X 9.161 INCH L | 80009 | 384-0348-01 |
| -70 | 175-3152-00 | | | 1 | | . . LEAD ASSY,ELEC:3,26 AWG,1.75 L | 80009 | 175-3152-00 |
| | 352-0161-00 | | | 1 | | . . . HLDR,TERM CONN:3 WIRE BLACK | 80009 | 352-0161-00 |
| -71 | 175-3153-00 | | | 1 | | . . LEAD ASSY,ELEC:2,26 AWG,2.5 L | 80009 | 175-3153-00 |
| | 352-0169-07 | | | 1 | | . . . CONN BODY,PL,EL:2 WIRE PURPLE | 80009 | 352-0169-07 |
| | 198-4197-00 | | | 1 | | . . WIRE SET,ELEC: | 80009 | 198-4197-00 |
| -72 | 175-0825-00 | | | FT | | . . . WIRE,ELECTRICAL:2 WIRE RIBBON | 80009 | 175-0825-00 |
| -73 | 175-0826-00 | | | FT | | . . . WIRE,ELECTRICAL:3 WIRE RIBBON | 80009 | 175-0826-00 |
| -74 | 175-0829-00 | | | FT | | . . . WIRE,ELECTRICAL:6 WIRE RIBBON | 08261 | SS-0626-710610C |
| -75 | 175-0833-00 | | | FT | | . . . WIRE,ELECTRICAL:10 WIRE RIBBON | 08261 | SS-1026-7 |
| -76 | 352-0169-03 | | | 1 | | . . . CONN BODY,PL,EL:2 WIRE ORANGE | 80009 | 352-0169-03 |
| | 352-0169-04 | | | 2 | | . . . CONN BODY,PL,EL:2 WIRE YELLOW | 80009 | 352-0169-04 |
| | 352-0169-05 | | | 2 | | . . . CONN BODY,PL,EL:2 WIRE GREEN | 80009 | 352-0169-05 |
| -77 | 352-0161-05 | | | 1 | | . . . CONN BODY,PL,EL:3 WIRE GREEN | 80009 | 352-0161-05 |
| | 352-0161-06 | | | 1 | | . . . CONN BODY,PL,EL:3 WIRE BLUE | 80009 | 352-0161-06 |
| -78 | 352-0164-06 | | | 2 | | . . . CONN BODY,PL,EL:6 WIRE BLUE | 80009 | 352-0164-06 |
| -79 | 352-0168-06 | | | 2 | | . . . CONN BODY,PL,EL:10 WIRE BLUE | 80009 | 352-0168-06 |
| -80 | 131-0707-00 | | | 40 | | . . . CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD | 22526 | 47439 |
| -81 | 131-0708-00 | | | 4 | | . . . CONTACT,ELEC:0.48"L,28-32 AWG WIRE | 22526 | 47437 |
| -82 | 131-2428-00 | | | 4 | | . . . CONN PLUG,ELEC:18-20 AWG,BRS& CU BE GOLD | 22526 | 47441 |
| | ----- ----- | | | 1 | | . SW,CAM ACTR AS:(SEE S20 REPL) | | |
| | | | | | | (ATTACHING PARTS) | | |
| -83 | 211-0116-00 | | | 4 | | . SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS | 83385 | OBD |
| | | | | | | - - - * - - - | | |
| | ----- ----- | | | - | | . CAM SWITCH ASSY INCLUDES: | | |
| -84 | 210-0406-00 | | | 7 | | . . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS | 73743 | 12161-50 |
| -85 | 401-0178-01 | | | 1 | | . . BEARING,CAM SW:CENTER/REAR | 80009 | 401-0178-01 |
| -86 | 105-0799-00 | | | 1 | | . . ACTUATOR,CAM SW:TIMING | 80009 | 105-0799-00 |
| -87 | 384-0878-23 | | | 1 | | . . SHAFT,CAM SW:4.514 L X 0.248 OD | 80009 | 384-0878-23 |
| | | | | | | (ATTACHING PARTS) | | |
| -88 | 354-0390-00 | | | 1 | | . . RING,RETAINING:0.338 ID X 0.025" THK,STL | 79136 | 5100-37MD |
| | | | | | | - - - * - - - | | |
| -89 | 214-1139-02 | | | 1 | | . . SPRING,FLAT:GREEN COLORED | 80009 | 214-1139-02 |
| | 214-1139-03 | | | 2 | | . . SPRING,FLAT:RED COLORED | 80009 | 214-1139-03 |
| -90 | 214-1752-00 | | | 2 | | . . ROLLER,DETENT: | 80009 | 214-1752-00 |
| -91 | 401-0180-00 | | | 1 | | . . BEARING,CAM SW:FRONT & REAR | 80009 | 401-0180-00 |
| -92 | ----- ----- | | | 1 | | . CKT BOARD ASSY:DIGITAL(SEE A2 REPL) | | |
| -93 | 131-0604-00 | | | 14 | | . . CONTACT,ELEC:CKT BD SW,SPR,CU BE | 80009 | 131-0604-00 |
| -94 | 131-0608-00 | | | 20 | | . . TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD | 22526 | 47357 |

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Qty | 1 2 3 4 5 | Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|---|---|
| 1-95 | 136-0153-00 | | | 1 | | . . SKT,PL-IN,ELEK:CRYSTAL,2 CONT,W/CLAMP | 91506 | 8000AG6 |
| | | | | | | (ATTACHING PARTS) | | |
| -96 | 210-0405-00 | | | 2 | | . . NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS | 73743 | 12157-50 |
| -97 | 210-0001-00 | | | 2 | | . . WASHER,LOCK:INTL,0.092 ID X 0.18"OD,STL | 78189 | 1202-00-00-0541C |
| -98 | 211-0001-00 | | | 2 | | . . SCREW,MACHINE:2-56 X 0.25 INCH,PNH STL | 87308 | OBD |
| | | | | | | - - - * - - - | | |
| -99 | 214-0579-00 | | | 5 | | . . TERM,TEST POINT:BRS CD PL | 80009 | 214-0579-00 |
| -100 | 337-1418-02 | | | 1 | | . . SHIELD,ELEC:CIRCUIT BOARD | 80009 | 337-1418-02 |
| | | | | | | (ATTACHING PARTS) | | |
| -101 | 211-0001-00 | | | 3 | | . . SCREW,MACHINE:2-56 X 0.25 INCH,PNH STL | 87308 | OBD |
| -102 | 210-0001-00 | | | 3 | | . . WASHER,LOCK:INTL,0.092 ID X 0.18"OD,STL | 78189 | 1202-00-00-0541C |
| | | | | | | - - - * - - - | | |
| -103 | 131-0589-00 | | | 7 | | . . TERMINAL,PIN:0.46 L X 0.025 SQ | 80009 | 131-0589-00 |
| -104 | 136-0260-02 | | | 2 | | . . SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CLE | 71785 | 133-51-92-008 |
| -105 | 334-3448-00 | | | 1 | | MARKER,IDENT:MARKED NOTICE | 80009 | 334-3448-00 |
| -106 | 334-3438-00 | | | 1 | | MARKER,IDENT:MARKED TURN OFF POWER | 80009 | 334-3458-00 |
| -107 | 426-0725-08 | | | 1 | | FR SECT,PLUG-IN:TOP | 80009 | 426-0725-08 |
| -108 | 426-0724-10 | | | 1 | | FR SECT,PLUG-IN:BOTTOM | 80009 | 426-0724-10 |

Fig. 5 Exploded View



| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Qty | 1 2 3 4 5 | Name & Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|---|---|---|
| | 070-2813-00 | | | 1 | | MANUAL,TECH:SERVICE | 80009 | 070-2813-00 |





@

# MANUAL CHANGE INFORMATION

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

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

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