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

# 7B15
# DELAYING TIME BASE

INSTRUCTION MANUAL

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

070-2318-00
Product Group 42

Serial Number _____

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## INSTRUMENT SERIAL NUMBERS

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

| | |
|---|---|
| B000000 | Tektronix, Inc., Beaverton, Oregon, USA |
| 100000 | Tektronix Guernsey, Ltd., Channel Islands |
| 200000 | Tektronix United Kingdom, Ltd., London |
| 300000 | Sony/Tektronix, Japan |
| 700000 | Tektronix Holland, NV, Heerenveen, The Netherlands |

# SERVICING SAFETY SUMMARY

## FOR QUALIFIED SERVICE PERSONNEL ONLY

Refer also to the preceding Operators Safety Summary

The following are safety precautions which appear in the servicing information sections of this manual. This Servicing Safety Summary is in addition to the Operators Safety Summary given previously.

**WARNING**

### DO NOT SERVICE ALONE

*Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.*

### DISCONNECT INSTRUMENT POWER

*To avoid electric-shock disconnect the instrument from the power source before removing protective panels, soldering, or replacing components.*

### SILICONE GREASE HANDLING

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

**CAUTION**

### AVOID EXCESSIVE MOISTURE

*Circuit boards and components must be dry before applying power to prevent damage from electrical arcing.*

### EXERCISE CARE WHEN CHECKING DIODES

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

### EXERCISE CARE WHEN SOLDERING ON MULTI-LAYER BOARDS

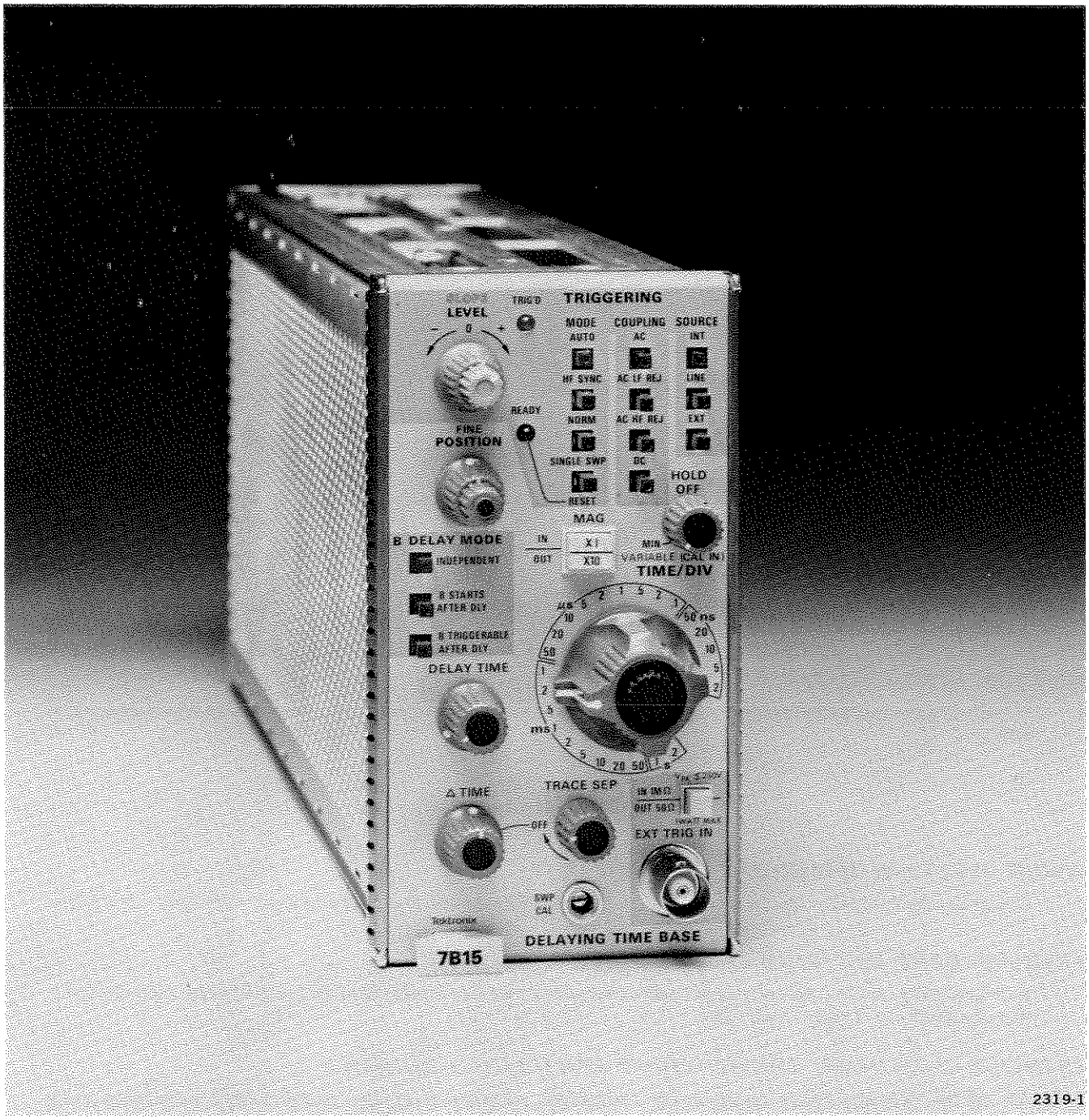
*All but the Readout circuit board in the instrument are multi-layer type boards with a conductive path laminated between the top and bottom board layers. All soldering on these boards should be done with extreme care to prevent breaking the connections to this center conductor. Only experienced maintenance personnel should attempt repair of these boards.*

### USE PROPER CLEANING AGENTS

*Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Use a non-residue type of cleaner, preferably isopropyl alcohol, totally denatured ethyl alcohol, or Freon TF. Before using any other type of cleaner, consult your Tektronix Service Center or representative.*

### DO NOT USE PIN SOCKETS FOR CONNECTION POINTS

*The spring tension of the pin sockets ensures a good connection between the circuit board and the pin. This spring tension can be destroyed by using the pin sockets as a connecting point for spring-loaded probe tips, alligator clips, etc.*




**7B15 Features**

The 7B15 Delaying Time-Base unit provides calibrated sweep rates from .2 seconds to 2 nanoseconds and triggering to 1 Gigahertz for 7100-, 7700-, 7800-, and 7900-series oscilloscopes. The X10 Magnifier increases each sweep rate by a factor of 10 and a VARIABLE control allows continuously variable sweep rates between calibrated steps. Variable hold off and alpha-numeric readouts are provided. Also, when operating in the AUTO TRIGGERING MODE, a bright baseline trace is displayed in the absence of a trigger signal.

Other features include independent sweep operation of continuously variable sweep delay (DELAY TIME) and differential sweep delay (△ TIME) with a companion time-base unit. Delay time or differential delay time readout is displayed on the mainframe cathode-ray tube.

# GENERAL INFORMATION

## INTRODUCTION

### OPERATORS MANUAL

The Operators Manual contains information necessary to effectively operate the 7B15 Time Base and is divided into three sections: Section 1 provides a basic description of the 7B15 with instrument specifications and accessories; section 2 contains operating information for the instrument; instrument option information is located in section 3 of the manual.

### INSTRUCTION MANUAL

The Instruction Manual provides both operating and servicing information for the 7B15 Time Base. The Instruction Manual is divided into nine sections. Operating information is covered in the first two sections; servicing information for use by qualified service personnel is contained in the remaining seven sections of the manual. Schematic diagrams are located at the rear of the manual and can be unfolded for reference while reading other parts of the manual. The reference designators and symbols used on the schematics are defined on the first page of the Diagrams and Circuit Board Illustrations section. All abbreviations used in this manual, with the exception of the parts lists and schematic diagrams, comply with the American National Institute Y1.1-1972 publication. The parts lists are computer printouts and use computer-supplied abbreviations. Instrument option information is located in section 6 of the Instruction Manual.

## INSTALLATION

The time-base unit is designed to operate in the horizontal plug-in compartment of the mainframe. This instrument 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 unit in a plug-in compartment, align the upper and lower rails of the plug-in with the mainframe tracks and push it in until it fits firmly into the compartment. The front panel of the unit should be flush with the front panel of the mainframe. Even though the gain of the mainframe is standardized, the sweep calibration of the unit should be checked when installed. The procedure for checking the unit is given under Sweep Functions in the Operators Checkout procedure in section 2.

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

## INSTRUMENT PACKAGING

If this instrument is to be shipped for long distances by commercial means of transportation, it is recommended that it be repackaged in the original manner for maximum protection. The original shipping carton should be saved and used for this purpose. If more information is needed, contact your local Tektronix Field Office or representative.

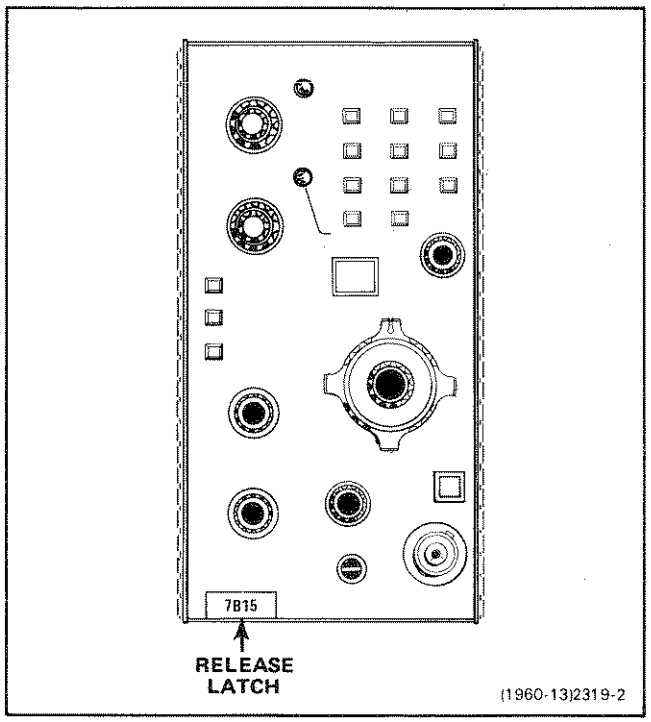



**Figure 1-1. Location of release latch.**

# SPECIFICATION

This instrument will meet the electrical characteristics listed in Table 1-1, following complete adjustment. The following electrical characteristics are valid over the stated environmental range for instruments calibrated at an ambient temperature of +20° to +30° C, and after a twenty-minute warmup unless otherwise noted.

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

| Characteristics | Performance Requirement | |
|---|---|---|
| **SWEEP GENERATOR** | | |
| Sweep Rates | | |
| Calibrated Range | 0.2 s/div to 2 ns/div in 25 steps. X10 Magnifier extends fastest calibrated sweep rate to 0.2 ns/div. | |
| Variable Range | Continuously variable uncalibrated sweep rate to at least 2.5 times the calibrated sweep rate setting. | |
| Sweep Accuracy[1] with 7104, 7900 and 7800 Series Mainframes | Measured over center 8 displayed divisions. SWP CAL is adjusted at 1 ms/div within the +20 to +30° C range. (7B15 Delay Mode Switch set to Independent.) | |
| +15 to +35° C | UNMAG | MAG X10 |
| 0.2 s/div to 10 ns/div | 2% | 3% |
| 5 ns/div and 2 ns/div | 3% | 4%[2] |
| 0 to +50° C | Derate +15 to +35° C accuracy by additional 1%. | |
| Excluded Portions of Sweep | | |
| 7104 | None. | |
| 7800, 7900 Series | First 5 ns. | |
| Sweep Length | At least 10.2 div. | |
| MAG Registration | 0.5 div or less from graticule center when changing from MAG X10 to MAG X1. | |
| Position Range | | |
| POSITION Controls fully CW | Start of sweep must be to right of graticule center at 1 ms/div. | |
| POSITION Controls fully CCW | End of sweep must be left of graticule center at 1 ms/div. | |

[1] Some mainframes limit fastest calibrated sweep rate.

[2] 200 ps/div is measured over any 5 divisions within the center 8 divisions.



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TABLE 1-1 (CONT.)
Electrical Characteristics

| Characteristics | Performance Requirement |
|---|---|
| **VARIABLE TIME DELAY** | |
| △ TIME | |
| Range | 0.0 to at least 9.0 times TIME/DIV setting. |
| Accuracy (20 ms/div to 100 ns/div) | |
| +15° to +35° C | Within (0.5% of Measurement + 3 digits). |
| 0° to +50° C | Within (0.5% of Measurement + 4 digits). |
| TRACE SEP Range | Functional only in the △ TIME Mode when alternating or chopping between timebase units. The second delayed sweep display can be vertically positioned at least 3 divisions below the first delayed sweep display when the mainframe vertical trace separation control is centered. |
| DELAY TIME | |
| Range | 0.2 or less to at least 9.0 times TIME/DIV setting. |
| Jitter | |
| 0.2 s/div to 50 μs/div | (0.02% of TIME/DIV setting) or less |
| 20 μs/div to 100 ns/div | (0.03% of TIME/DIV setting + 100 ps) or less. |
| Absolute Delay Accuracy (Start of delayed sweep with respect to start of delaying sweep; 0° to +50° C) | |
| 0.2 s/div to 10 μs/div | Within (0.5% of Delay + 5% of TIME/DIV setting). |
| Differential Measurement Accuracy (Measurement is made by subtracting 2 delay time readings; 0.2 s/div to 100 ns/div; 0° to 50° C) | Within (0.5% of Measurement + 4 digits). |

## TRIGGERING

| Trigger Sensitivity for Repetitive Signals | Triggering Frequency Range[3] | Minimum Triggering Signal Required | |
|---|---|---|---|
| Coupling | | Internal | External |
| AC | 30 Hz to 250 MHz<br>250 MHz to 1 GHz | 0.5 div<br>1.5 div | 50 mV<br>150 mV |
| AC LF REJ[4] | 50 kHz to 250 MHz<br>250 MHz to 1 GHz | 0.5 div<br>1.5 div | 50 mV<br>150 mV |
| AC HF REJ | 30 Hz to 30 kHz | 0.5 div | 50 mV |
| DC[5] | Dc to 250 MHz<br>250 MHz to 1 GHz | 0.5 div<br>1.5 div | 50 mV<br>150 mV |

[3]The triggering frequency ranges given here are limited to the -3 dB frequency of the oscilloscope vertical system when operating in the Internal mode.

[4]Will not trigger on sine waves at or below 60 Hz when amplitudes are less than 8 divisions Internal or 3 volts External.

[5]The Triggering Frequency Range for DC COUPLING applied to frequencies above 30 Hz when operating in the AUTO TRIGGERING MODE.

**TABLE 1-1 (CONT.)**
**Electrical Characteristics**

| Characteristics | Performance Requirement |
|---|---|
| Single Sweep | Same as for Repetitive and Pulsed Triggering. |
| Internal Trigger Jitter | 30 ps or less at 1 GHz. |
| Operating in HF SYNC MODE | |
| AC, AC LF REJ, or DC | 250 MHz to 1 GHz - 0.3 div Internal<br>75 mV External |
| External Trigger Input | |
| LEVEL RANGE | At least + and −3.5 V (checked on 1 kHz sine wave). |
| Maximum Safe Input | |
| 1-Megohm Input | 250 V (dc plus peak ac). |
| 50-Ohm Input | 1 Watt average. |
| Input R and C | |
| 1-Megohm Input | 1 MΩ within 5%, 20 pf within 10%. |
| 50-Ohm Input | 50 Ω within 2%. |
| Trigger Holdoff Time | |
| Minimum Holdoff Setting[6] | |
| 0.2 s/div to 50 ms/div | 40 ms, or less |
| 20 ms/div to 2 μs/div | 2 times TIME/DIV setting, or less |
| 1 μs/div to 2 ns/div | 2.0 μs, or less |
| Maximum Holdoff Setting[6] | |
| 0.2 s/div to 50 ms/div | 400 ms, or greater |
| 20 ms/div to 2 μs/div | 20 times TIME/DIV setting, or greater |
| 1 μs/div to 0.5 μs/div | 20.0 μs, or greater |
| 0.2 μs/div to 2 ns/div | 6.0 μs, or greater |

[6]Performance requirement not checked in the manual.

**TABLE 1-2**
**Environmental Characteristics**

| |
|---|
| Refer to the Specification section of the associated mainframe manual. |

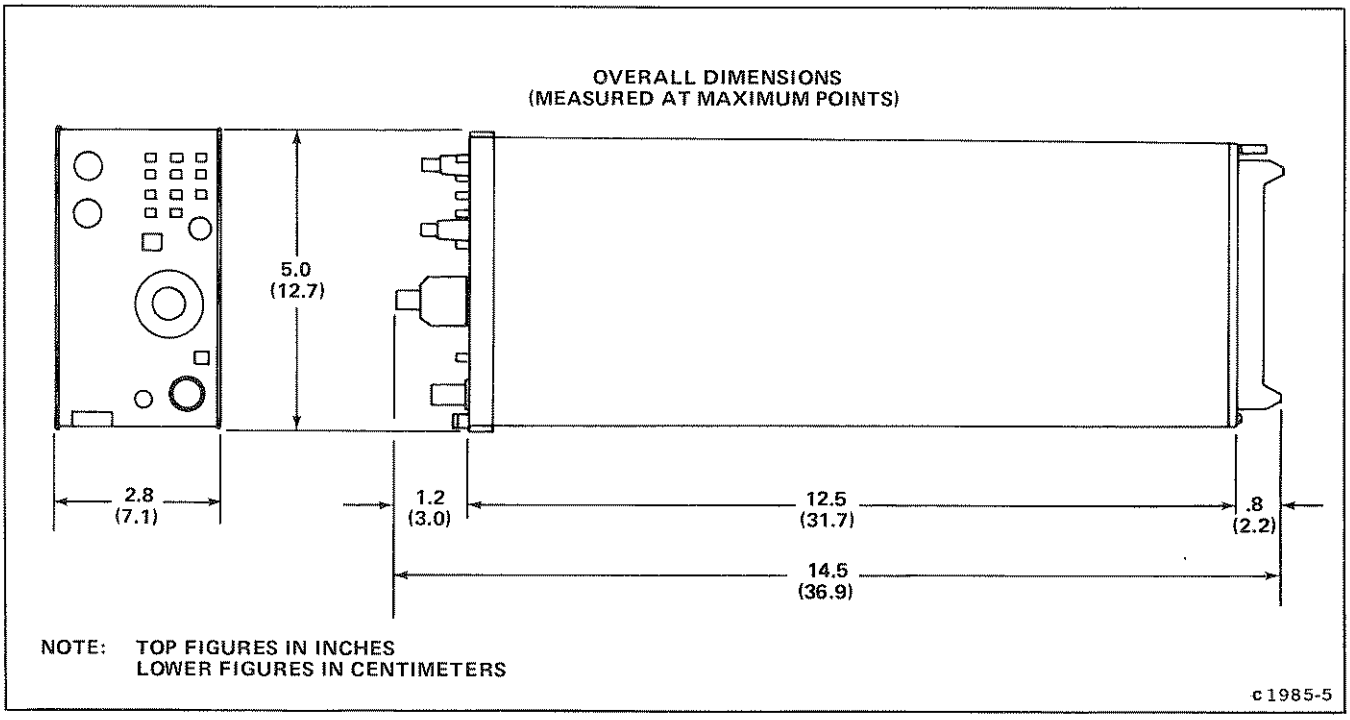
**TABLE 1-3**
**Physical Characteristics**

| | |
|---|---|
| Net Weight | Approximately 2.6 pounds (1.2 kilogram). |
| Dimensions | See Figure 1-2, dimensional drawing. |

# STANDARD ACCESSORIES

1 ea.....Operators Manual

1 ea.....Instruction Manual




Figue 1-2. 7B15 dimensional drawing.

# OPERATING INSTRUCTIONS

The 7B15 Time-Base unit operates with a Tektronix 7100-, 7700-, 7800-, or 7900-series oscilloscope mainframe and a 7A-series amplifier unit to form a complete oscilloscope system. This section describes the operation of the front-panel controls and connectors, provides detailed operating information, an operators checkout procedure, and basic applications for this instrument.

## 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 portion of this section.

## OPERATORS CHECKOUT

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 functional check procedure reveals a malfunction or possible maladjustment, first check the operation of the associated plug-in units, then refer to the instruction manual for maintenance and adjustment procedures.

### SETUP PROCEDURE

1. Install the 7B15 in the A horizontal compartment of the mainframe.

2. Install an amplifier plug-in unit in a vertical compartment.

3. Set the 7B15 controls as follows:

| | |
|---|---|
| SLOPE | (+) |
| MODE | AUTO |
| COUPLING | AC |
| SOURCE | INT |
| B DELAY MODE | INDEPENDENT |
| TRACE SEP | OFF (fully clockwise) |
| POSITION | Midrange |
| TIME/DIV | 1 ms |
| VARIABLE (CAL IN) | Calibrated (Pushed in) |
| HOLD OFF | MIN (fully counterclockwise) |
| MAG | X1 (pushed in) |
| EXT TRIG IN | OUT 50 Ω |

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

5. Set the mainframe vertical and horizontal modes to display the plug-in units used and adjust the intensity and focus 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 Setup Procedure.

2. Connect a 0.4-volt, 1-kilohertz signal from the mainframe calibrator to the amplifier plug-in unit input.

3. Set the amplifier plug-in unit deflection factor for 4 divisions of display.

4. Adjust the LEVEL control for a stable display.

5. Turn the POSITION control and note that the trace moves horizontally.

6. Turn the FINE control and note that the display can be precisely positioned horizontally.

7. Check the display for one complete cycle per division. If necessary, adjust the front-panel SWP CAL screwdriver adjustment for one complete cycle per division over the center 8 graticule divisions. Be sure that the timing of the mainframe calibrator signal is accurate to within 0.25% (+20° to +30° C).

8. Press to release the VARIABLE (CAL IN) control. Turn the VARIABLE (CAL IN) control fully counterclockwise and note that the displayed sweep rate changes to at least the next slower TIME/DIV switch setting (i.e., 2 milliseconds/division). Press the VARIABLE (CAL IN) knob in 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 to release the MAG button (X10). Note that the unmagnified display within the center division of the graticule is magnified to about 10 divisions.

3. Press the MAG button (X1).

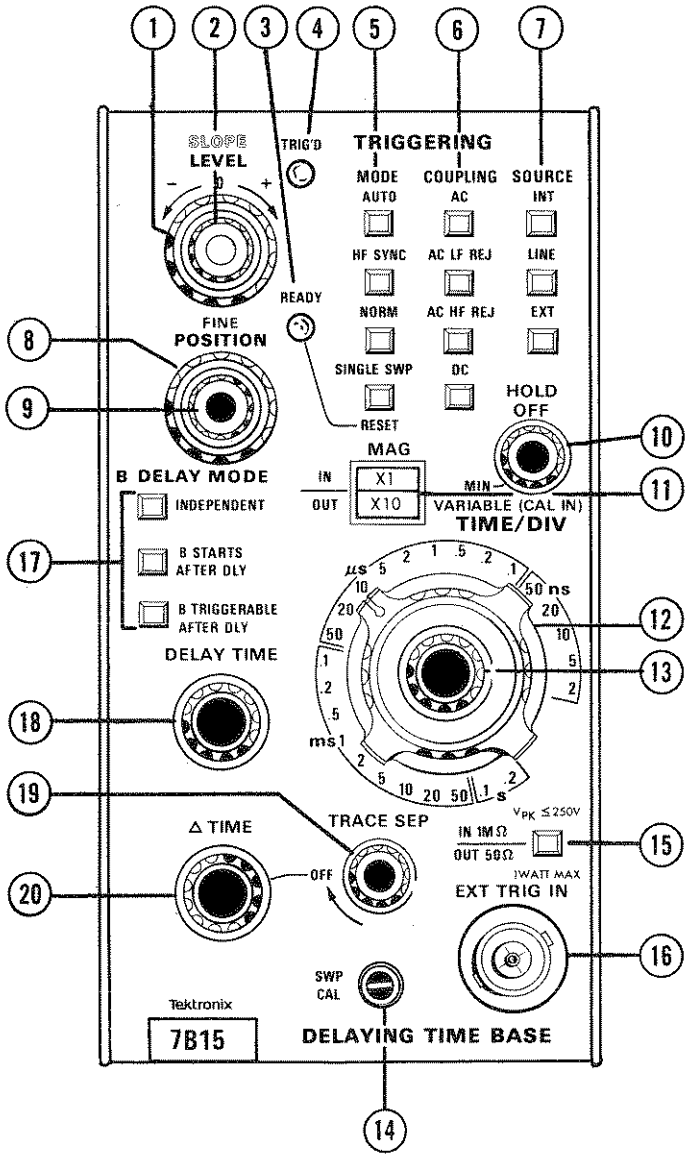



Figure 2-1. Front-panel controls, connectors and indicators.

## TRIGGERING

(1) LEVEL Control—Selects a point on the trigger signal where triggering occurs.

(2) SLOPE Switch—Permits sweep to be triggered on negative- or positive-going portions of the trigger signal.

(3) READY Indicator—Illuminates when sweep circuit is armed (SINGLE SWP MODE).

(4) TRIG'D Indicator—Illuminates when the display is triggered.

(5) MODE Pushbuttons—Selects the operating mode of the triggering circuits.

(6) COUPLING Pushbuttons—Selects the method of coupling the trigger signal to triggering circuit.

(7) SOURCE Pushbuttons—Selects source of the trigger signal.

## SWEEP

(8) POSITION Control—Provides horizontal positioning.

(9) FINE Control—Provides precise horizontal positioning.

(10) HOLD OFF Control—Permits hold off period to be varied to improve triggering stability of repetitive complex waveforms.

(11) MAG Pushbutton—Selects X10 magnified or unmagnified sweep.

(12) TIME/DIV Switch—Selects the sweep rate of the sweep generator.

(13) VARIABLE Control and CAL Switch—Selects calibrated or uncalibrated sweep rates. Uncalibrated sweep rates can be continuously reduced to at least the sweep rate of the next slower position.

(14) SWP CAL Adjustment—Compensates for basic timing changes due to the differences in sensitivity of mainframes in which the 7B15 may be used.

## EXTERNAL TRIGGER INPUT

(15) EXT TRIG Button—Selects input impedance.

(16) EXT TRIG IN Connector—Connector (BNC type) provides input for external trigger signals.

## SWEEP MODE

(17) B DELAY MODE Pushbuttons—Selects independent or delaying sweep operation. In the B STARTS AFTER DLY and B TRIGGERABLE AFTER DLY delaying sweep modes, the DELAY TIME and △ TIME functions are activated. There will be a 2 division vertical shift of the trace when switching from INDEPENDENT to B STARTS AFTER DLY.

## DELAY TIME

(18) DELAY TIME Control—Provides variable delay time before the start of the delayed sweep produced by companion time-base unit.

(19) TRACE SEP Control and Switch—Enables △ TIME functions and provides vertical separation of the delayed sweep traces (△ TIME operation).

(20) △ TIME Control—Provides differential time measurements between 2 selected intensified zones on the delaying sweep trace. Two delayed sweep traces corresponding to the intensified zones are displayed by the companion time-base unit. Differential time is displayed on the crt readout.

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

### Delaying And Delayed Sweep

Perform the following procedure to obtain delaying- and delayed-sweep displays and to demonstrate the function of the related controls. To obtain a delayed-sweep display, a companion time-base unit must be installed in the B horizontal compartment of the mainframe.

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

2. Press the B STARTS AFTER DELAY button.

3. Set the mainframe horizontal mode for chopped operation.

4. Set the companion time-base unit sweep rate for 0.1 millisecond/ division, and triggering for auto mode, ac coupling, internal source, and + slope.

5. Adjust the mainframe B sweep intensity and check for an intensified zone about 1 division wide on the delaying (A) sweep display. Also note that the delayed (B) sweep provides an expanded display of the intensified portion of the delaying (A) sweep.

6. Position the start of the delaying (A) sweep to the left edge of the graticule.

7. Adjust the DELAY TIME control for a crt readout (bottom division of crt graticule) of 5.000 ms. Check that the left edge of the intensified zone is at the graticule center line.

8. Set the 7B15 TIME/DIV switch to .5 ms and the delayed (B) sweep unit sweep rate to 20 microseconds/division.

9. Turn the DELAY TIME control fully counterclockwise to position the intensified zone near the front corner of the first square-wave cycle. Press the B TRIGGERABLE AFTER DLY button and check that the intensified zone moves to the front corner of the next displayed square wave.

### △ (Differential) Time

Perform the following procedure to obtain a △ (differential) time display and to demonstrate the function of the related controls:

1. Obtain a delaying (A) and delayed (B) sweep display as described in steps 1 through 4 of the preceding Delaying and Delayed Sweep procedure.

2. Turn the TRACE SEP control counterclockwise out of the OFF (detent) position.

3. Set the DELAY TIME and △ TIME controls to the fully counterclockwise position. Check for two delayed (B) sweeps and note that the crt readout (bottom right of crt) is 0.000 ms.

4. Slowly turn the △ TIME control clockwise and note that a second intensified zone moves across the delaying (A) sweep display and the crt readout indicates the differential time between the left edge of the stationary intensified zone and the left edge of the second intensified zone. Also note that the lower delayed (B) sweep is an expanded display of the second intensified zone.

## 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.Turn the LEVEL control fully counterclockwise to obtain a free-running sweep.

3. Slowly turn the HOLD OFF control clockwise and note that a stable display can be obtained at several positions of the HOLD OFF control. Return the HOLD OFF control to the fully counterclockwise (MIN) position.

**NOTE**

*The HOLD OFF control varies the sweep hold-off time which effectively changes the repetition rate of the horizontal sweep signal. However, its primary function is to obtain a stable display of complex waveforms which are otherwise difficult to trigger.*

4. Press the AC, AC HF REJ, and DC COUPLING buttons for both the + and - positions of the SLOPE switch and check for a stable display (LEVEL control may be adjusted, if necessary, to obtain a stable display).

5. Apply the 0.4-volt, 1 kilohertz signal from the mainframe calibrator to the amplifier plug-in unit and to the EXT TRIG IN connector.

6. Press the EXT SOURCE button and set the amplifier plug-in unit deflection factor for a 4-division display.

7. Press the AC, AC HF REJ, and DC COUPLING buttons for both the + and - positions of the SLOPE switch and check for a stable display (LEVEL control may be adjusted, if necessary, for a stable display).

8. Press the AC COUPLING, INT SOURCE, and NORM MODE buttons. Adjust the LEVEL control for a stable display.

9. Press the AUTO MODE button and adjust the LEVEL control for a free-running display.

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

11. Adjust the LEVEL control for a stable display and press the SINGLE SWP MODE button.

12. Note that one trace occurs when the SINGLE SWP button is pressed again.

13. Disconnect the mainframe calibrator signal from the amplifier plug-in unit input and press the SINGLE SWP button. Check for no display and note that the READY indicator is lit.

14. Note that one trace occurs and that the READY indicator extinguishes when the mainframe calibrator signal is reconnected to the amplifier plug-in unit input.

# DETAILED OPERATING INFORMATION

## Triggering Switch Logic

The MODE, COUPLING, and SOURCE push buttons of the TRIGGERING switches are arranged in a sequence which places the most-often used position at the top of each vertical row of push buttons. With this arrangement, a stable display can usually be obtained by pressing the top push buttons: AUTO, AC, INT. When an adequate trigger signal is applied and the LEVEL control is correctly set, the unit is triggered as indicated by the illuminated TRIG'D light. If the TRIG'D light is not on, the LEVEL control is either at a setting outside the range of the trigger signal applied to this unit from the vertical unit; the trigger signal amplitude is inadequate, or its frequency is below the lower frequency limit of the AC COUPLING switch position. If the desired display is not obtained with these buttons pushed in, other selections must be made. Refer to the following discussions or the instruction manuals for the associated oscilloscope mainframe and vertical unit(s) for more information.

## TRIGGERING MODES

The MODE push-button 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 control whenever an adequate trigger signal is applied (see Trigger Level discussions). The TRIG'D light indicates when the display is triggered.

When the trigger repetition rate is outside the frequency range selected by the COUPLING switch or the trigger signal is inadequate, the sweep free runs at the rate indicated by the TIME/DIV switch (TRIG'D indicator off). An adequate trigger signal ends the free-running condition and a triggered display is presented. The sweep also free runs at the rate indicated by the TIME/DIV switch when the LEVEL 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).

### Hf Sync

The HF SYNC mode provides a triggered display with the correct setting of the LEVEL control whenever a high frequency, (100 MHz or higher) low amplitude signal is applied. This mode is most useful when the incoming signal is too small to produce stable triggering in the AUTO or NORMAL modes. The HF SYNC mode increases trigger sensitivity and provides automatic trigger amplifier centering for optimum triggering under these conditions.

### Normal

The NORM MODE provides a triggered display with the correct setting of the LEVEL control whenever an adequate trigger signal is applied. The TRIG'D light indicates when the display is triggered.

The normal trigger mode must be used to produce triggered displays with trigger repetition rates below about 30 hertz. When the TRIG'D light is off, no trace is displayed.

### Single Sweep

When the signal to be displayed is not repetitive or varies in in amplitude, waveshape, or repetition rate, a conventional repetitive type display may produce an unstable presentation. Under these circumstances, a stable display can often be obtained by using the single-sweep feature of this unit. The single-sweep mode is also useful to photograph non-repetitive or unstable displays.

To obtain a single-sweep display of a repetitive signal, first obtain the best possible display in the NORM MODE. Then, without changing the other TRIGGERING controls, press the SINGLE SWP RESET button. A single trace is presented each time this button is pressed. Further sweeps cannot be presented until the SINGLE SWP 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. To avoid confusion due to the crt persistence, allow the display to disappear before pressing the SINGLE SWP RESET button again. 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 over-exposing 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 SWP 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 unit. Further information on photographic techniques is given in the appropriate camera instruction manual.

## TRIGGER COUPLING

The TRIGGERING COUPLING push buttons select the method in which the trigger signal is connected to the trigger circuits. Each position permits selection or rejection of some frequency components of the signal which triggers the sweep.

### Alternating Current

AC COUPLING blocks the dc component of the trigger signal. Signals with low-frequency components below about 30 hertz are attenuated. In general, AC COUPLING can be used for most applications. However, if the signal contains unwanted frequency components or if the sweep is to be triggered at a low repetition rate or dc level, one of the other COUPLING switch positions will provide a better display.

### Alternating Current Low Frequency Rejection

AC LF REJ COUPLING rejects dc, and attenuates low-frequency trigger signals below about 50 kilohertz. Therefore, the sweep is triggered only by the higher-frequency components of the trigger signal. This position is particularly useful for providing stable triggering if the trigger signal contains linefrequency components. Also, the AC LF REJ position provides the best alternate-mode vertical displays at fast sweep rates when comparing two or more unrelated signals.

### Alternating Current High Frequency Rejection

AC HF REJ COUPLING passes all low-frequency signals between about 30 hertz and 30 kilohertz. Dc is rejected and signals outside the above range are attenuated. When triggering from complex waveforms, this position is useful to provide a stable display of the low-frequency components.

### Direct Current

DC COUPLING can be used to provide stable triggering from low-frequency signals which would be attenuated in other COUPLING switch positions. DC COUPLING can be used to trigger the sweep when the trigger signal reaches a dc level set by the LEVEL control. When using internal triggering, the setting of the vertical plug-in unit position control affects the triggering point.

## TRIGGER SOURCE

The TRIGGERING SOURCE push buttons select the source of the trigger signal which is connected to the trigger circuits.

### Internal

The INT position connects the trigger signal from the vertical plug-in unit. Further selection of the internal trigger signal may be provided by the vertical plug-in unit or by the mainframe; 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 in the INT position. 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.

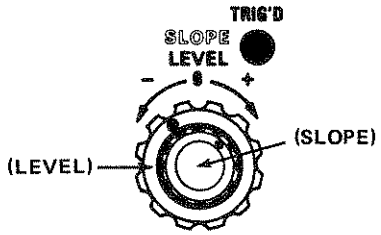
### External

The EXT position connects the signal from the EXT TRIG IN 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. It 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 TRIG IN 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.

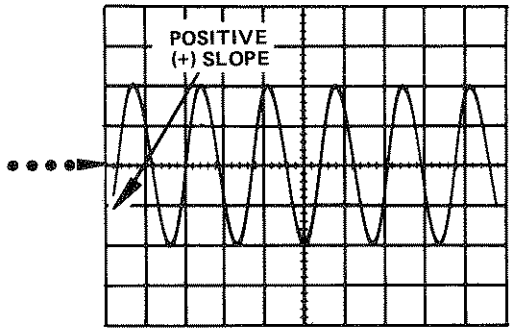
The IN 1MΩ/OUT 50Ω push button provides a convenient means of selecting external trigger input impedance. Pushing the button in sets the amplifier input impedance to 1 MΩ and the OUT position provides 50Ω input impedance.

## TRIGGER SLOPE

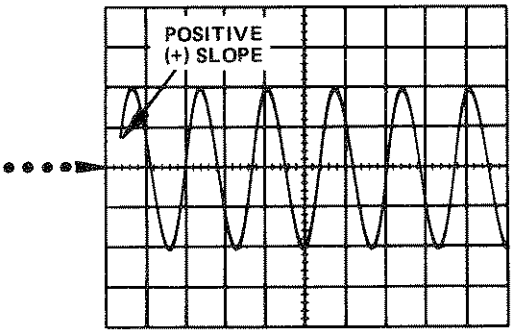
The TRIGGERING SLOPE switch (concentric with the TRIGGERING LEVEL control) determines whether the trigger circuit responds on the positive- or negative-going portion of the trigger signal. When the SLOPE switch is in the (+) (positive-going) position, the display starts on the positive-going portion of the waveform (see Fig. 2-2). When several cycles of a signal appear in 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.




CRT DISPLAY
OBTAINED WITH
SLOPE SWITCH
SET TO POSITIVE(+)

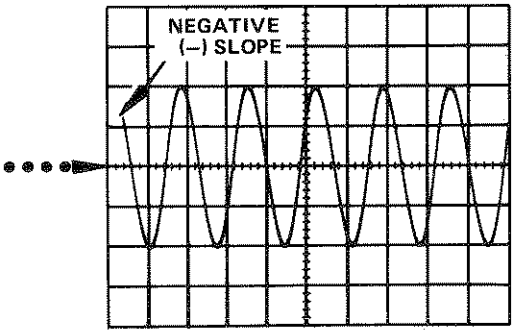


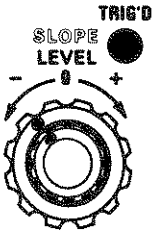


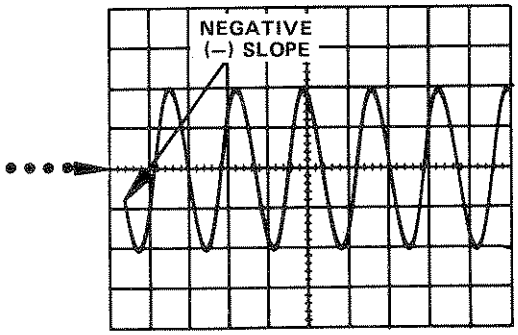




CRT DISPLAY
OBTAINED WITH
SLOPE SWITCH
SET TO NEGATIVE (–)




C1958-7

Figure 2-2. Effects of LEVEL control and SLOPE switch on crt display.

## TRIGGER LEVEL

The TRIGGERING LEVEL control determines the voltage level on the trigger signal at which the sweep is triggered. When the LEVEL control is set in the + region, the trigger circuit responds at a more positive point on the trigger signal. When the LEVEL control is set in the - region, the trigger circuit responds at a more negative point on the trigger signal. Figure 2-2 illustrates this effect with different settings of the SLOPE switch.

To set the LEVEL control, first set the TRIGGERING MODE, COUPLING, SOURCE, and slope. Then set the LEVEL control fully counterclockwise and rotate it clockwise until the display starts at the desired point. Less selection of the triggering level is available as the trigger signal frequency exceeds 150 megahertz.

In the HF SYNC mode, the trigger LEVEL control varies the sensitivity of the trigger generator. The LEVEL control is set to provide a stable display.

## HORIZONTAL SWEEP RATES

The TIME/DIV switch provides calibrated sweep rates from 0.2 seconds/ division to 2 nanoseconds/division in a 1-2-5 sequence. The VARIABLE TIME/DIV control must be in the calibrated position and the MAG switch set to X1 to obtain the sweep rate indicated by the TIME/DIV switch. However, the mainframe crt readout will display the appropriate sweep rate.

The VARIABLE TIME/DIV control includes a two-position switch to determine if the sweep rate is calibrated, or uncalibrated. When the VARIABLE control is pressed in, it is inoperative and the sweep rate is calibrated. When pressed and released outward, the VARIABLE control is activated for uncalibrated sweep rates, to at least the sweep rate of the next slower position.

A calibrated sweep rate can be obtained in any position of the VARIABLE control by pressing the VARIABLE control. This feature is particularly useful when a specific uncalibrated sweep rate has been obtained and it is desired to switch between calibrated and uncalibrated displays.

## TIME MEASUREMENT

When making time measurements from the graticule, the area between the second and tenth vertical lines of the graticule provides the most linear time measurements (see Fig. 2-3). Position the start of the timing area to the second vertical line and adjust the TIME/DIV switch so 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 center division of the unmagnified display is the portion visible on the crt in the magnified

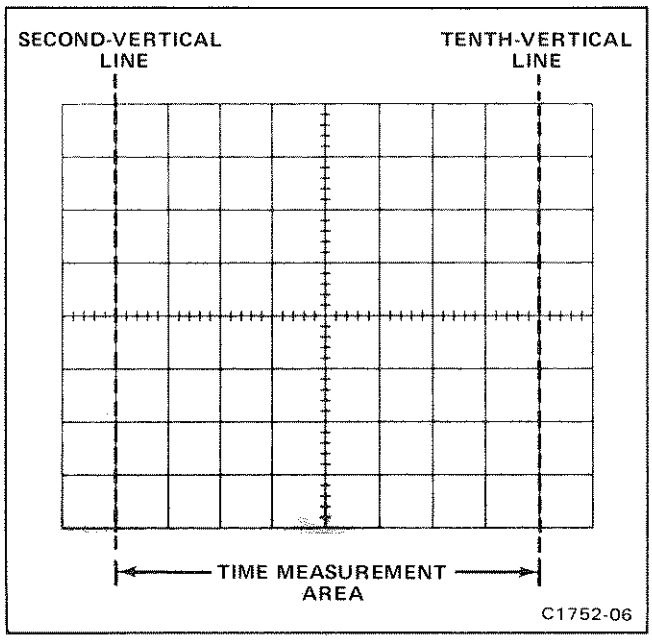



**Figure 2-3. Area of graticule used for most accurate time measurements.**

form (see Fig. 2-4). The equivalent length of the magnified sweep is more than 100 divisions; any 10-division portion can be viewed by adjusting the POSITION and FINE POSITION controls to bring the desired portion into the viewing area.

When the MAG switch is set to X10 (OUT), the equivalent magnified sweep rate can be determined by dividing the TIME/DIV setting by 10; the equivalent magnified sweep rate is displayed on the crt readout.

## VARIABLE HOLD OFF

The HOLD OFF control improves triggering stability on repetitive complex waveforms by effectively changing the repetition rate of the horizontal sweep signal. The HOLD OFF control should normally be set to its minimum setting. When a stable display cannot be obtained with the TRIGGERING LEVEL control, the HOLD OFF control can be varied for an improved display. If a stable display cannot be obtained at any setting of the LEVEL and HOLD OFF controls, check the TRIGGERING COUPLING and SOURCE switch settings.

## DELAY-TIME OPERATION

A 7B15 installed in the mainframe A horizontal compartment can delay a companion time-base unit installed in the B horizontal compartment. When operating the 7B15 in a delaying mode (B DELAY MODE switch set to B STARTS AFTER DLY or B TRIGGERABLE AFTER DLY), an intensified zone is provided on the delaying sweep display during the time that the

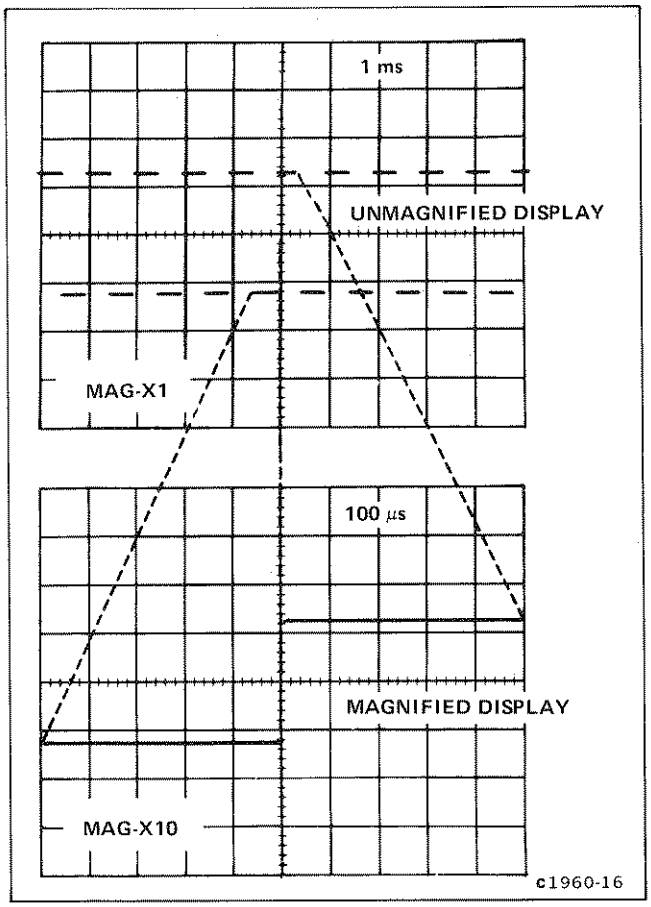



**Figure 2-4. Effect of sweep magnifier on crt display.**

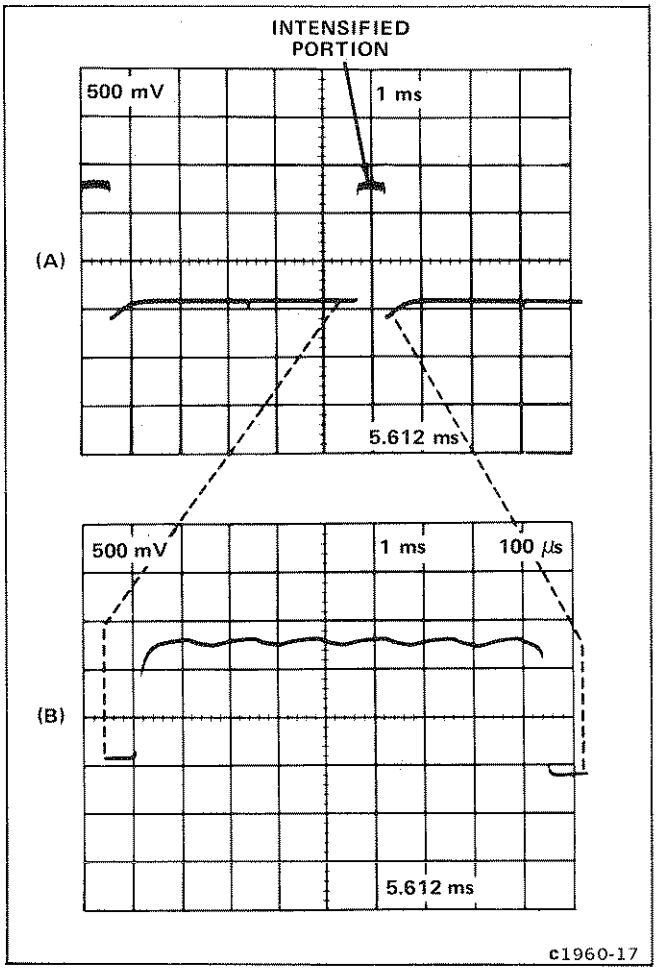



**Figure 2-5. (A) Delaying-sweep display produced by 7B15 in the A horizontal compartment. (B) Delayed-sweep display produced by companion time-base unit in the B horizontal compartment.**

companion time-base unit runs (see Fig. 2-5). A delayed-sweep trace is provided by the companion time-base unit, corresponding to the intensified zone on the delaying trace, at the sweep rate set by the time/div switch of the companion time-base unit (see Fig. 2-5). The delay time between the triggering event which starts the delaying-sweep trace and the start of the intensified zone (and corresponding delayed sweep), is determined by the 7B15 TIME/DIV switch and DELAY TIME control. The amount of calibrated delay time is displayed on the crt readout.

To view the delaying-sweep trace (intensified display), set the mainframe horizontal mode switch to A; to view the corresponding delayed-sweep trace, set the mainframe horizontal mode switch to B. To view the delaying trace (intensified) and the corresponding delayed-sweep trace on the same display, set the mainframe horizontal mode switch to alternate or chop.

Triggering for the delaying-sweep trace is controlled by the 7B15 TRIGGERING controls. Triggering for the intensified zone on the delaying-sweep trace and the corresponding delayed-sweep trace is controlled by the triggering controls of the companion time-base unit when the 7B15 is in the B TRIGGERABLE AFTER DLY mode.

Delay-time measurements must be made with the B DELAY MODE switch set to B STARTS AFTER DLY. When the B DELAY MODE switch is set to B TRIGGERABLE AFTER DLY, the delayed sweep starts with the first trigger pulse after the delay time shown on the crt readout. Therefore, precision time measurements cannot be made in this mode because the time delay is only partially dependent on the DELAY TIME control. The crt readout displays the greater-than symbol (>) preceding the delay time when operating in the B TRIGGERABLE AFTER DLY mode to indicate that the delay time is uncalibrated. However, the B TRIGGERABLE AFTER DLY mode is useful for triggering on waveforms with excessive jitter.

## △ TIME OPERATION

The △ TIME delaying mode provides the best means of making differential time measurements. The 7B15 can delay a companion time-base unit at 2 separate delay times. At the end of the first delay time (determined by the 7B15 DELAY TIME control and TIME/DIV switch) an

intensified zone is provided on the delaying-sweep trace. Further, a separate delayed-sweep trace corresponding to the first intensified zone is provided. At the end of the second delay time (determined by the 7B15 TIME/DIV switch, the DELAY TIME, and △ TIME controls) a second intensified zone and corresponding second delayed-sweep trace are displayed (see Fig. 2-6). The 7B15 must be installed in the A horizontal compartment. The companion time-base unit must be installed in the B horizontal compartment. The TRACE SEP control must be rotated counterclockwise out of the switch detent position for △ TIME operation. The sweep rate for the delaying-sweep trace is determined by the 7B15 TIME/DIV switch, and the sweep rate of the intensified zones and corresponding delayed-sweep display is determined by the sweep rate setting of the companion time-base unit.

The differential time between the start of the first intensified zone and the start of the second intensified zone is displayed on the crt readout (see Fig. 2-6). A △ symbol preceding the delay-time readout indicates a differential measurement. The > (greater than) symbol following the △ symbol indicates that the TIME/DIV VARIABLE control is activated or that the B DELAY MODE switch is set to B TRIGGERABLE AFTER DLY and therefore the differential time is uncalibrated.

The TRACE SEP control vertically positions the second delayed-sweep trace with respect to the first delayed-sweep trace. Vertical positioning of the delayed-sweep trace is provided by the vertical separation control on the oscilloscope mainframe.

### △ Time Operation In A Dual-Beam Oscilloscope Mainframe

The 7B15 △ TIME function is compatible with 7000-series dual-beam mainframes and operation is basically the same as given for [delta] Time Operation. The 7B15 must be installed in the A horizontal compartment and the companion time-base unit must be installed in the B horizontal compartment, as with conventional 4 plug-in compartment mainframes. Set the horizontal mode switch so that the 7B15 provides horizontal deflection for one beam and the companion time-base unit provides horizontal deflection for the other beam. Apply the input signal to the desired vertical plug-in unit and select that unit for vertical deflection of both beams.

Operation of the △ TIME mode in dual-beam mainframes with a dedicated vertical system differs slightly from conventional dual-beam mainframes with vertical-mode switches. The plug-in unit in the left vertical compartment provides vertical deflection of beam 1 and the plug-in unit in the right vertical compartment provides vertical deflection for beam 2. Therefore, the input signal must be applied to the units in both the left and right vertical compartments for △ TIME operation.

### MAINFRAME OPERATING MODES

The 7B15 can also be operated either as an independent time base in any Tektronix 7100-, 7700-, 7800-, or 7900-series mainframes, or as a delayed-sweep unit (B DELAY MODE switch set to INDEPENDENT) in those mainframes that have two horizontal compartments. A companion delaying time-base unit (e.g., another 7B15) is required for delayed-sweep operation. Refer to Applications in this section for additional information.

## APPLICATIONS

The 7B15 is designed primarily for use with a companion time-base unit in a readout-equipped mainframe to make delayedsweep time-interval measurements. The 7B15 can also be used as an independent non-delaying time base. The following procedures provide instructions for making several delayed-sweep time-interval measurements using the delay-time and △ (differential) time modes. These procedures provide enough detail to enable the operator to adapt them to other related time-interval measurements. Contact your Tektronix Field Office or representative for assistance in making measurements not described in this manual.

## DELAYED-SWEEP MEASUREMENTS

Complex signals often consist of a number of individual events of differing amplitudes. Since the trigger circuits are sensitive only to changes in signal amplitude, a stable display can normally be obtained only when the sweep is triggered by the event(s) having the greatest amplitude. However, this may not produce the desired display of a lower amplitude portion which follows the triggering event. The delayed-sweep feature provides a means of delaying the start of the delayed sweep by a selected amount following the event which triggers the sweep generator. Then, the part of the waveform which contains the information of interest can be displayed at the delayed-sweep rate with a higher apparent magnification than is provided by the MAG switch.

The delayed-sweep feature can also be used to provide rapid and accurate time-interval measurements from a triggering event (i.e., the start of the delaying sweep) to a selected point or between two selected points on a displayed waveform. See General Operating Information in this section for a further discussion of delay-time operation.

In the delay-time mode, the delayed (B) sweep runs for a selected interval after the delaying (A) sweep as indicated by an intensified zone superimposed on the delaying (A) sweep trace. The length of the intensified zone indicates the time that the delayed sweep runs and is determined by the delayed (B) sweep plug-in unit sweep rate (TIME/DIV setting). The time from the start of the delaying (A) sweep to the start of the intensified zone (i.e., the start of the delayed sweep) can be read directly on the crt readout.

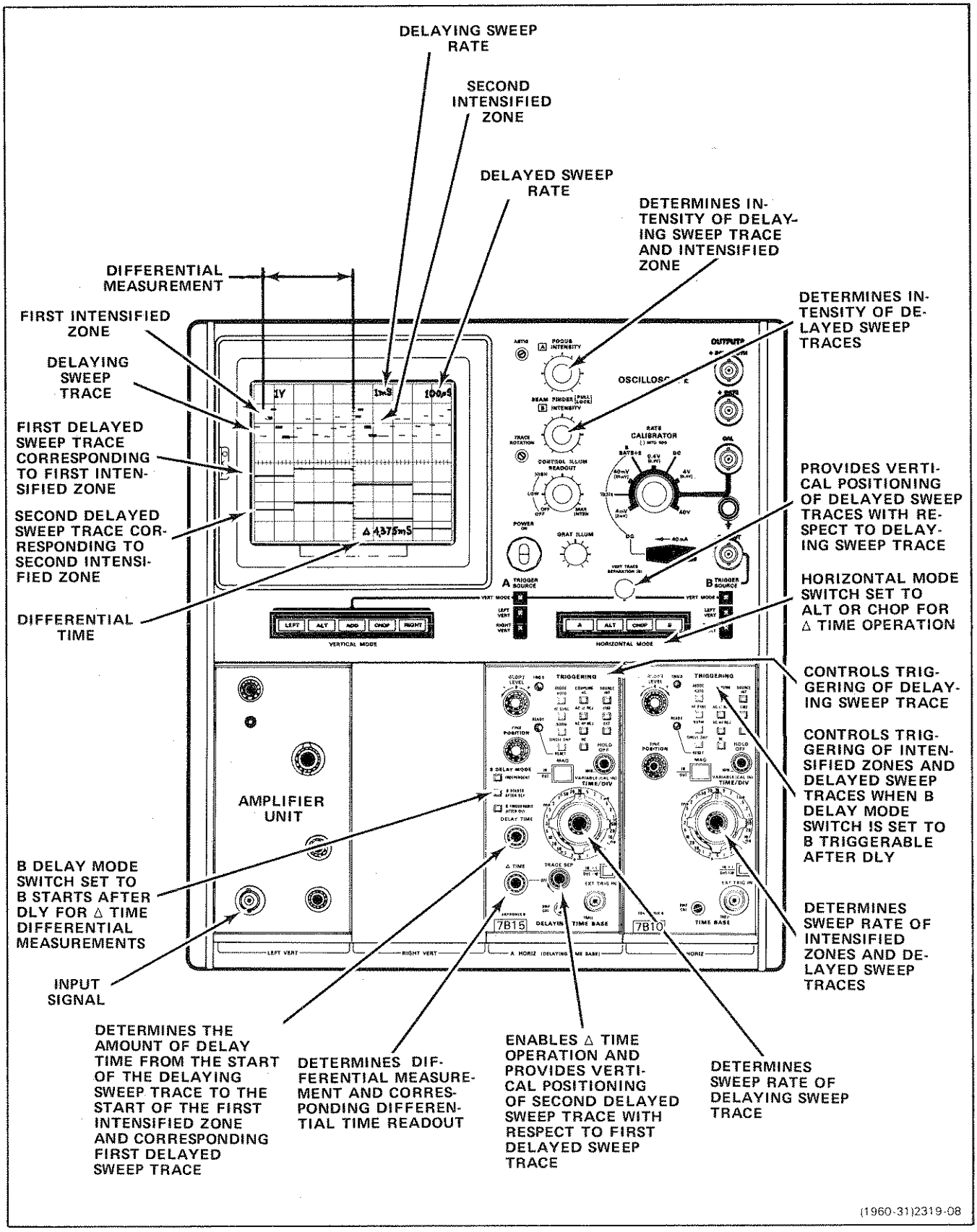



Figure 2-6. Typical Δ (Differential) Time Operation.

In the △ (differential) time mode, the delayed (B) sweep runs for a second selected interval indicated by a second intensified zone superimposed on the delaying (A) sweep trace. The two intensified zones can be positioned with the DELAY TIME and △ TIME controls. The crt readout then indicates the differential (△) time from the start of the first to the start of the second intensified zones.

By selecting the mainframe alternate or chopped horizontal operation, the delaying (A) sweep and either the first delayed (B) sweep interval (delay-time mode) or both delayed (B) sweep intervals (△ time mode) can be displayed simultaneously. Since the delayed (B) sweep(s) can be displayed at a higher magnification than is available with the MAG switch, more precise selection of time intervals is possible.

The following procedures provide instructions for making several types of time-interval measurements in the delay-time and delta (differential) time modes.

## TIME-INTERVAL MEASUREMENTS (DELAY-TIME MODE)

Perform the following procedure to measure the time from a triggering event (start of sweep) to any point on a displayed waveform:

1. Install the 7B15 in the mainframe A horizontal compartment and a companion time-base unit in the B horizontal compartment.

2. Set the 7B15 controls as follows:

B DELAY MODE..... B STARTS AFTER DLY (button in)
MAG.....X1 (button in)
HOLD OFF ..... MIN (fully counterclockwise)
TRACE SEP ..... OFF (fully clockwise)
VARIABLE TIME/DIV .....CALIBRATED (knob in)

3. Connect the signal to be measured to the vertical plug-in unit input.

4. Set the mainframe for the A horizontal mode to display the 7B15, and the vertical mode to display the vertical plug-in unit.

5. Set the TRIGGERING controls for a stable display (see General Operating Information in this section for selecting proper triggering).

6. Set the vertical deflection factor and 7B15 sweep rate for the desired display. See the example in Figure 2-7.

7. Set the delayed (B) unit sweep rate for about a 0.5 division intensified zone.

8. Rotate the DELAY TIME control to position the leading edge of the intensified zone at the point on the displayed waveform where the desired time interval ends.

9. Read the time interval from the start of the sweep to the leading edge of the intensified zone directly on the crt readout (see Figure 2-7).

## DIFFERENTIAL TIME-INTERVAL MEASUREMENTS (DELTA TIME MODE)

Perform the following procedure to measure the time-interval between any two selected points on a waveform. This procedure can be used to measure the rise time, fall time, period, frequency, or pulse width of a displayed waveform.

1. Install the 7B15 in the mainframe A horizontal compartment and a companion time-base unit in the B horizontal compartment.

2. Set the 7B15 controls as follows:

B DELAY MODE..... B STARTS AFTER DLY (button in)
MAG.....X1 (button in)
HOLD OFF ..... MIN (fully counterclockwise)
TRACE SEP ..... OFF (fully clockwise)
VARIABLE TIME/DIV .....Calibrated (knob in)

3. Connect the signal to be measured to the vertical plug-in unit input.

4. Set the mainframe for the A horizontal mode to display the 7B15 and the vertical mode to display the vertical plug-in unit.

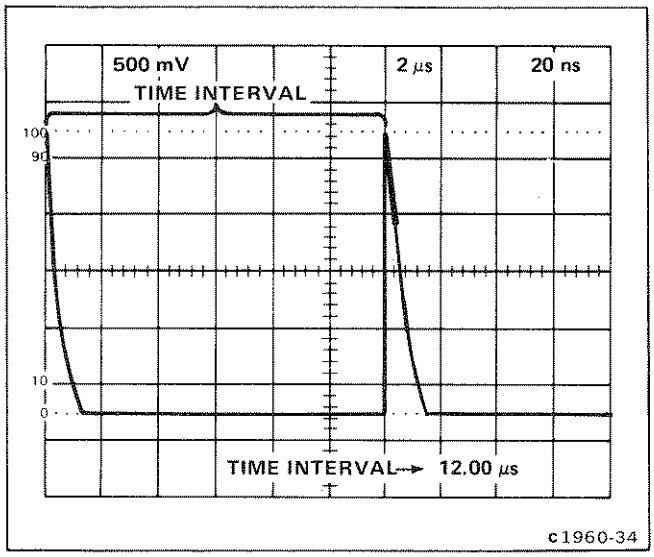



**Figure 2-7. Measuring time intervals from a triggering event (start of sweep) to any point on a waveform.**

5. Set the TRIGGERING controls for a stable display (see General Operating Information in this section for selection of proper triggering).

6. Set the appropriate triggering, position, deflection-factor, and sweep-rate controls to obtain the desired display. See the examples in Figure 2-8.

7. Adjust the DELAY TIME control to position the leading edge of the first intensified zone to the beginning of the time interval to be measured (see Fig. 2-8, point A).

8. Turn the TRACE SEP control counterclockwise just out of the OFF (detent) position to obtain a second intensified zone (delta time mode) on the display.

9. Adjust the △ TIME control to position the leading edge of the second intensified zone to the end of the time interval to be measured (see Fig. 2-8, point B).

10. Read the time interval between the intensified zones directly from the crt readout.

**NOTE**

*For more accurate time-interval measurements with a dual-trace magnified display, refer to the Delayed-Sweep Magnification procedure.*

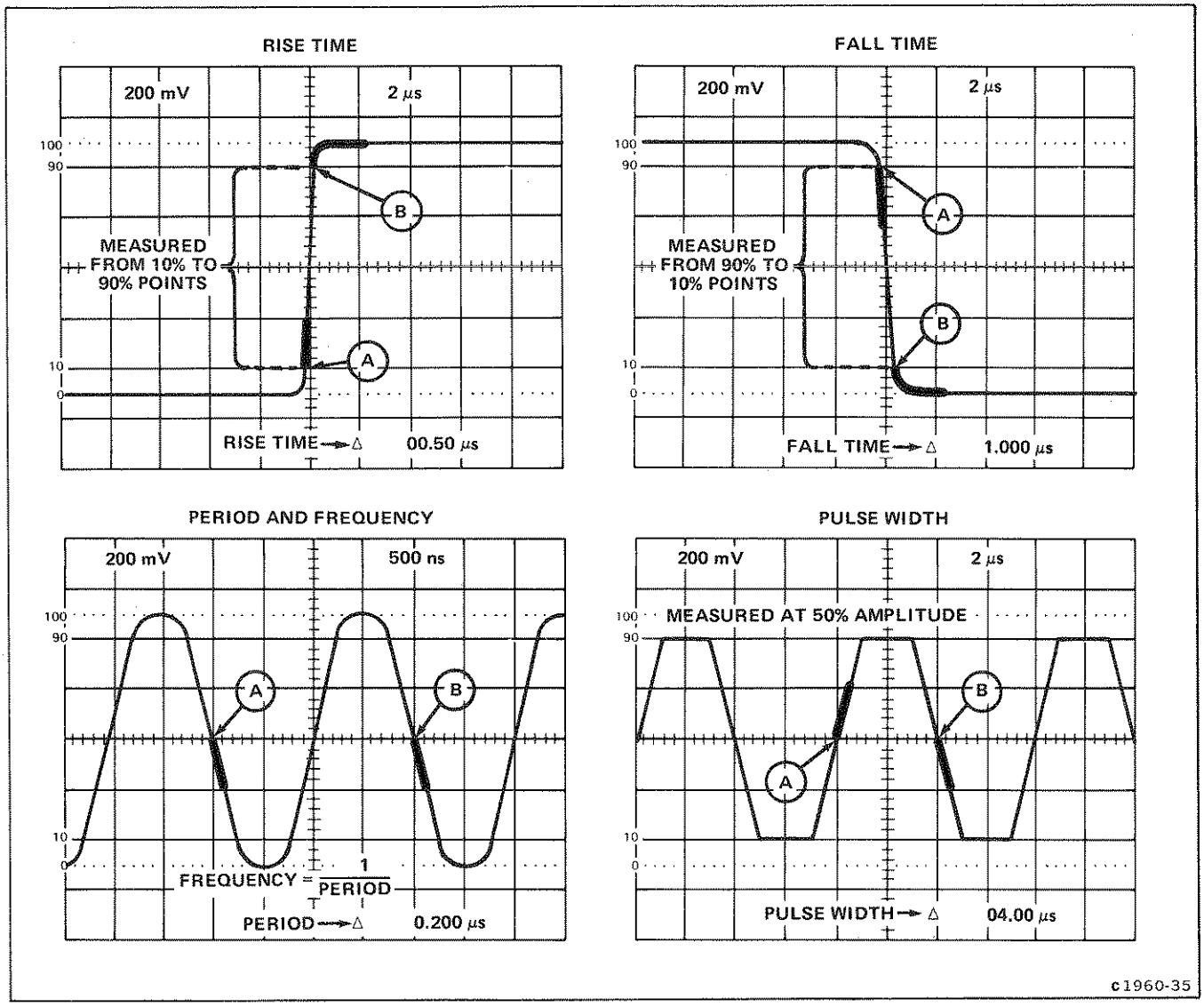



Figure 2-8. Measuring risetime, fall time, period, frequency, or pulse width in the △ (differential) time mode.

## DELAYED-SWEEP MAGNIFICATION

By selecting the mainframe alternate or chopped horizontal mode, a dual-trace display of both the delaying (A) sweep and the delayed (B) sweep can be obtained. In the delay-time mode (i.e., TRACE SEP control in the OFF position), the delayed (B) sweep appears as a magnified display of the single intensified portion on the delaying (A) sweep trace. In the delta (differential) time mode (i.e., TRACE SEP control rotated counterclockwise out of the OFF position), the delayed (B) sweep appears as a dual magnified display of both intensified portions of the delaying (A) sweep trace. The dual-delayed (B) sweep displays can be superimposed or separated by rotating the TRACE SEP control.

The following procedures use alternate or chopped horizontal (dual-trace) operation to: Magnify a selected segment of the delaying (A) sweep and determine apparent magnification in the delay-time mode, (2) make more accurate time-interval measurements in the delay-time and △ (differential) time modes, and (3) examine an event that occurs within a selected time interval after a known delay time in the delay-time mode.

1.Install the 7B15 in the mainframe A horizontal compartment and a companion time-base unit in the B horizontal compartment.

2. Set the 7B15 controls as follows:

B DELAY MODE..... B STARTS AFTER DLY (button in)
MAG ..... X1 (button in)
HOLD OFF ..... MIN (fully counterclockwise)
VARIABLE TIME/DIV .....Calibrated (knob in)
TRACE SEP ..... OFF (fully clockwise)

3. Connect the signal to be measured to the vertical unit input.

4. Set the mainframe horizontal mode for alternate or chopped operation (see oscilloscope mainframe instruction manual for discussion of alternate or chopped operation).

5. To magnify a selected segment of the delaying (A) sweep waveform and determine apparent magnification in the delay-time mode:

a. Perform the procedure in step 1 through 4.

b. Set the appropriate triggering, position, deflection-factor, and sweep-rate controls for the desired dual-trace display. See the example in Figure 2-9.

**NOTE**

*If there is excessive jitter in the delayed (B) sweep display, refer to the Triggered Delayed Sweep Magnification discussion.*

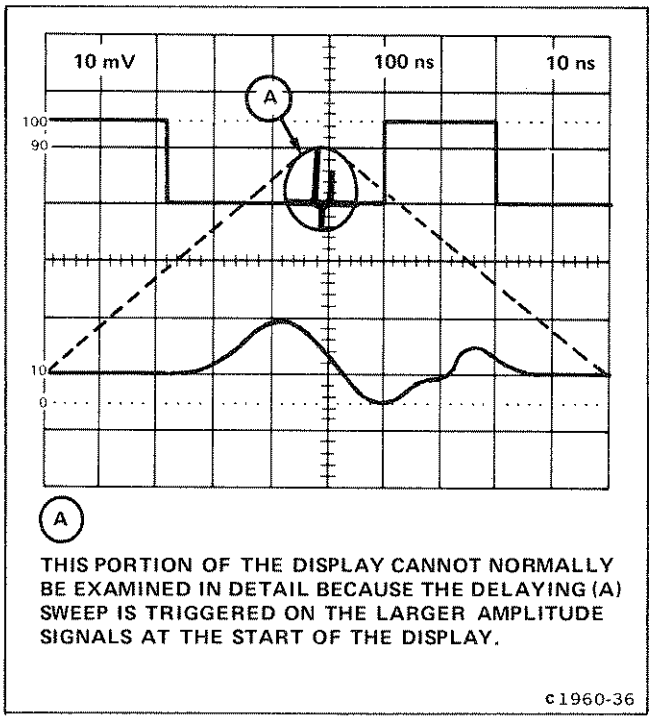



**Figure 2-9. Magnifying a selected segment of the delaying (A) sweep in the delay-time mode with mainframe alternate or chopped horizontal operation.**

c. Turn the DELAY TIME control to position the intensified zone to the portion of the delaying (A) sweep waveform to be magnified.

d. Set the delayed (B) sweep unit sweep rate to select the desired duration of the magnified display as indicated by the length of the intensified zone.

e. Observe the magnified display on the delayed (B) sweep. See Figure 2-9.

**NOTE**

*For a better look at the delayed (B) sweep waveform, set the mainframe to the B horizontal mode and the amplifier plug-in unit deflection factor to increase the display amplitude. Do not change the 7B15 TIME/DIV setting.*

f. Determine apparent magnification by dividing the 7B15 TIME/DIV setting by the delayed (B) sweep unit sweep-rate setting.

Example: The apparent magnification of the delayed (B) sweep shown in Figure 2-9 with a 7B15 TIME/DIV setting of .1 millisecond and a delayed (B) sweep unit sweep-rate setting of 1 microsecond is:

$$\text{Apparent Magnification} = \frac{\text{7B15 TIME/DIV setting}}{\text{(B) Sweep Time/Div setting}}$$

Substituting values:

$$\text{Apparent Magnification} = \frac{1 \times 10^{4}}{1 \times 10^{6}} = 100$$

The apparent magnification of the delayed (B) sweep display is 100 times the delaying (A) sweep display.

6. To make more accurate time interval measurements in the delay-time or △ (differential) time mode:

a. Perform the procedures in steps 1 through 4.

**NOTE**

*The remaining steps of this procedure apply for both delay-time and △ (differential) time measurements. For △ (differential) time operation, the 7B15 TRACE SEP control must be turned counterclockwise out of the OFF (detent) position. The △ TIME control then positions the second intensified zone and the DELAY TIME control positions the first intensified zone. Parentheses are used to indicate the instructions that apply only to △ (differential) time operation.*

b. Set the appropriate triggering, position, deflection factor, and sweep-rate controls for the desired dual-trace display. See the examples in Figure 2-10.

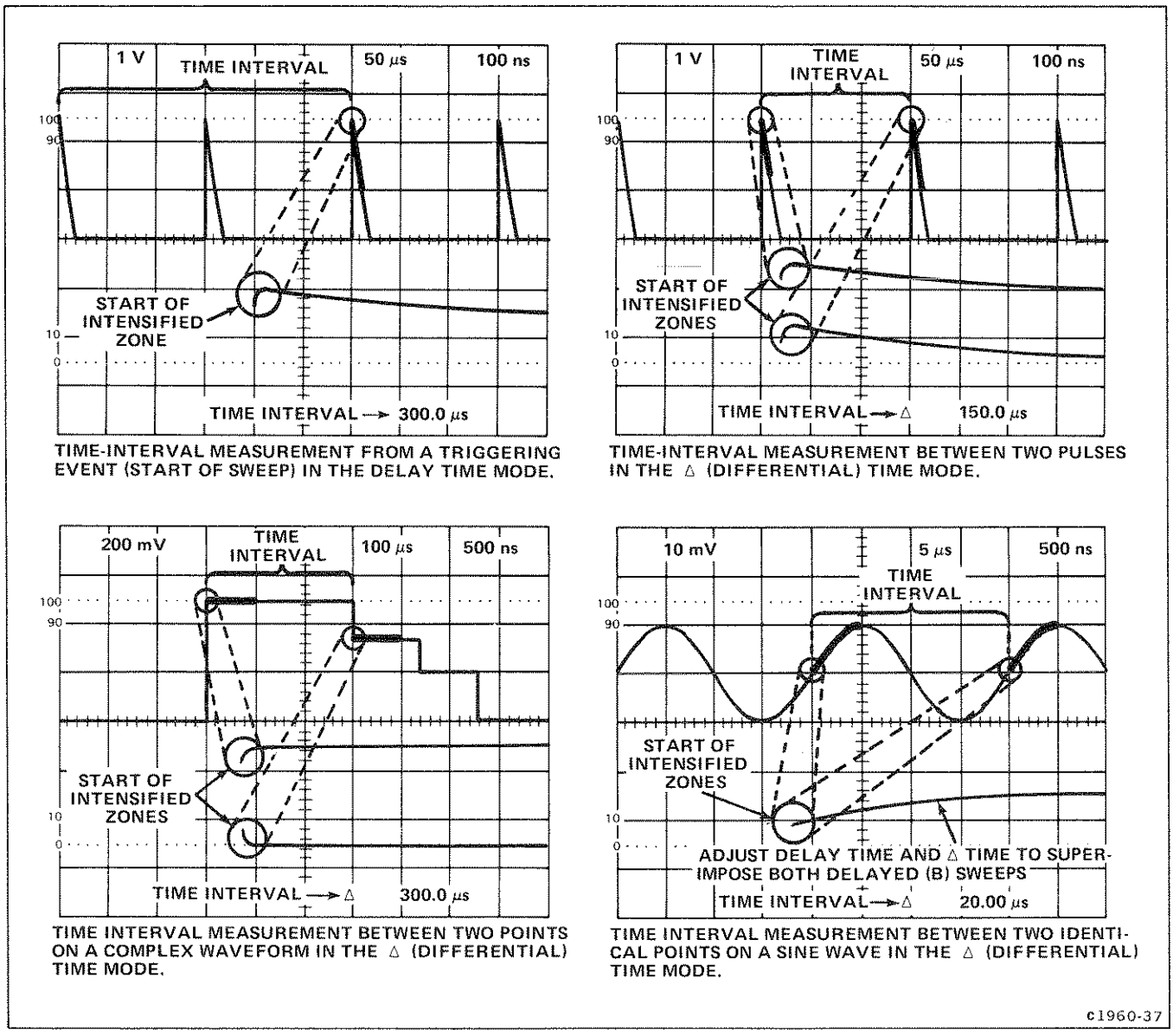



Figure 2-10. Time-interval measurements in the delay-time and △ (differential) time mode with mainframe alternate or chopped operation.

**NOTE**

*If there is excessive jitter in the delayed (B) sweep display, refer to the Triggered Delayed Sweep Magnification discussion.*

c. Turn the DELAY TIME (and delta TIME) control(s) to position the intensified zone(s) for the precise time interval to be measured using the magnified delayed (B) sweep waveform(s). See the examples in Figure 2-10.

**NOTE**

*For a better look at the delayed (B) sweep waveform, set the mainframe to the B horizontal mode and the amplifier-unit deflection-factor to increase the display amplitude. Do not change the 7B15 TIME/DIV setting.*

d. Read the desired time interval directly on the crt readout.

7. To examine an event that occurs within a selected time interval after a known delay time in the delay-time mode:

a. Perform the procedures in steps 1 through 4.

b. Set the appropriate triggering, position, deflection-factor, and sweep-rate controls for the desired dual-trace display. See the example in Figure 2-11.

**NOTE**

*If there is excessive jitter in the delayed (B) sweep display, refer to the Triggered Delayed Sweep Magnification discussion.*

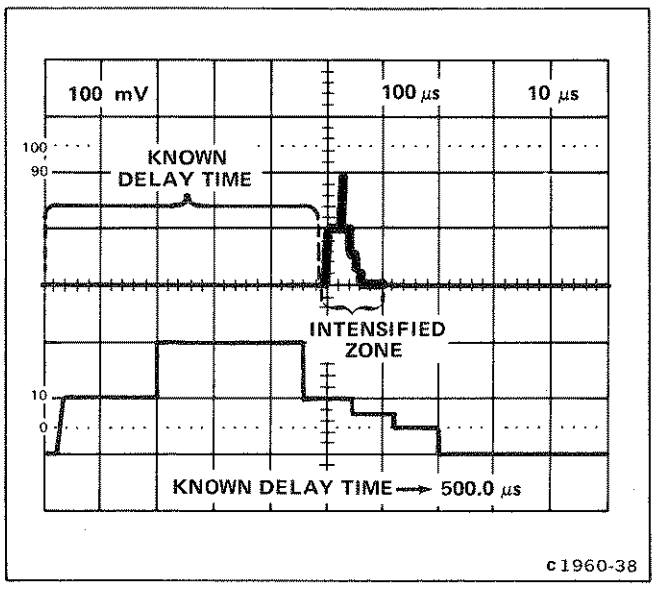



**Figure 2-11. Examining an event that occurs within a selected time interval after a known delay time in the delay-time mode.**

c. Adjust the DELAY TIME control for the known delay time as indicated on the crt readout.

d. Set the delayed (B) sweep rate (i.e., the intensified zone length) for the desired time interval after the delay time selected in part c. Multiply the delayed (B) sweep rate by 10 to determine the actual displayed delayed (B) sweep time interval. See the example in Figure 2-11.

e. Observe the magnified event to be examined on the delayed (B) sweep.

**NOTE**

*For a better look at the delayed (B) sweep waveform, set the mainframe to the B horizontal mode and the amplifier plug-in unit deflection-factor to increase the display amplitude. Do not change the 7B15 TIME/DIV setting.*

### TRIGGERED DELAYED-SWEEP MAGNIFICATION

The displayed waveform may have excessive jitter at the faster delayed (B) sweep-rate settings. The B TRIGGERABLE AFTER DLY position (button in) of the B DELAY MODE switch provides a more stable display, since the delayed (B) sweep display is then triggered at the same point each time. The crt readout is uncalibrated in this mode as indicated by the > symbol.

Inability to obtain the intensified zone(s) on the delaying (A) sweep display indicates that the delayed (B) sweep triggering controls are incorrectly set, or that the input signal does not meet triggering requirements. If the condition cannot be corrected with the triggering controls, or by increasing the display amplitude, externally trigger the delayed (B) sweep.

## INDEPENDENT TIME-INTERVAL MEASUREMENTS

The 7B15 is designed primarily for use with a companion time-base unit in 7100-, 7700-, 7800-, or 7900-series oscilloscope mainframes with two horizontal compartments and crt readout. However, the 7B15 can also be used as an independent nondelaying time base (e.g., in a compatible mainframe with one horizontal compartment). To operate the 7B15 as an independent time base for time-interval measurements, press the INDEPENDENT button and obtain the desired display as described in step 2 through 6 of the Time-Interval Measurements (Delay-Time Mode) procedure. Measure time intervals by multiplying the horizontal distance, in divisions, between the desired measurement points times the TIME/DIV switch setting.