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

7B85 DELAYING TIME BASE

WITH OPTIONS

OPERATORS

INSTRUCTION MANUAL

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

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Product Group 42

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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

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SAFETY SUMMARY

This manual contains safety information which the user must follow to ensure safe operation of this instrument. WARNING information is intended to protect the operator, CAUTION information is intended to protect the instrument. The following are general safety precautions that must be observed during all phases of operation.

WARNING

Ground the Instrument

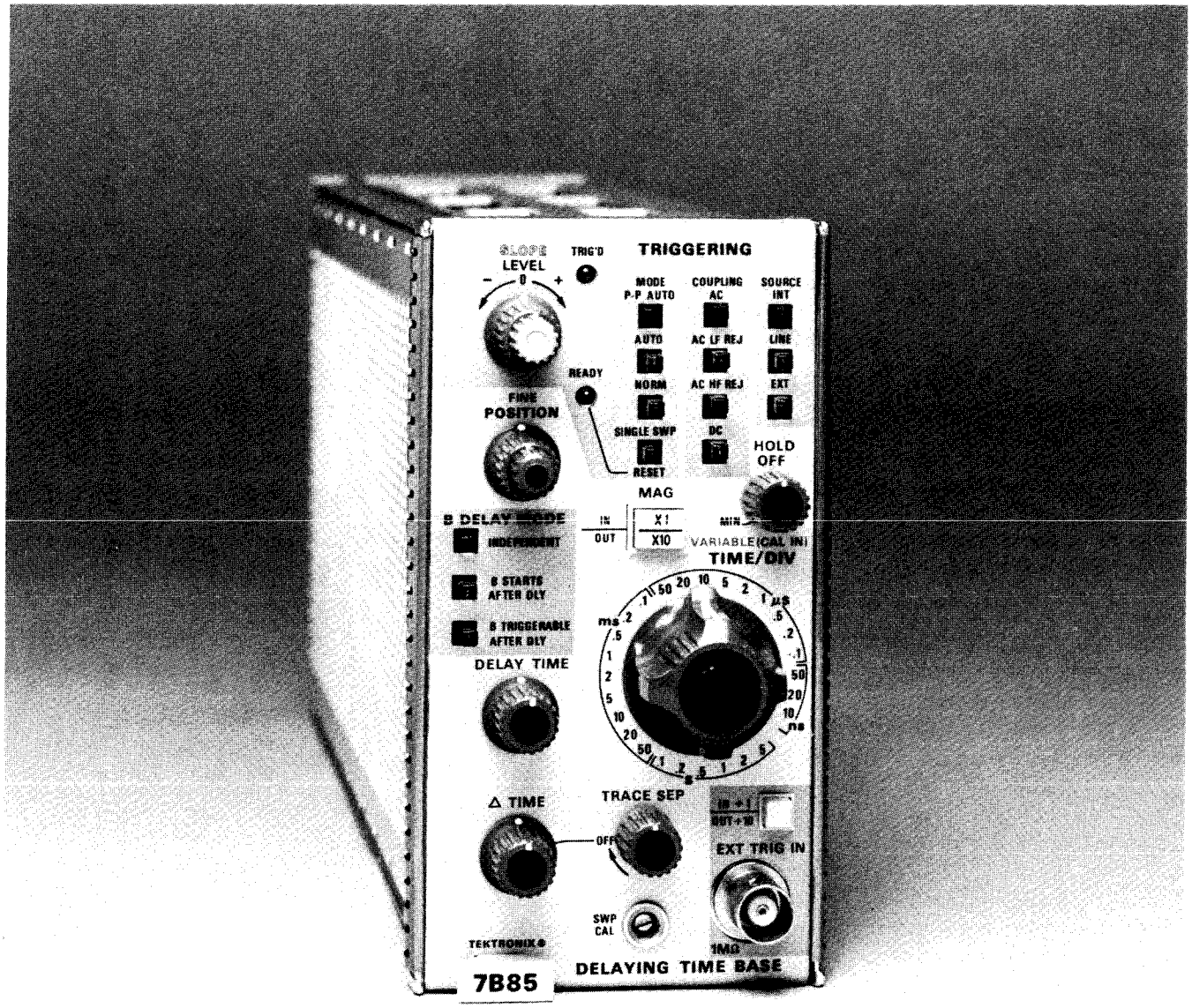
To reduce electrical-shock hazard, the mainframe (oscilloscope) chassis must be properly grounded. Refer to the mainframe manual for grounding information.

Do Not Operate in Explosive Atmosphere

Do not operate this instrument in an area where flammable gases or fumes are present. Such operation could cause an explosion.

Avoid Live Circuits

Electrical-shock hazards are present in this instrument. The protective instrument covers must not be removed by operating personnel. Component replacement and internal adjustments must be referred to qualified service personnel.



7B85 Features

The 7B85 Delaying Time-Base unit provides calibrated sweep rates from 5 seconds to 10 nanoseconds and triggering to 400 megahertz for 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 readout 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 or continuously variable sweep delay (DELAY TIME) and differential sweep delay (Δ TIME) with a companion time-base unit. Delay time or differential delay time readout is displayed on the mainframe cathode-ray tube.

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OPERATING INSTRUCTIONS

The 7B85 Time-Base unit operates with a Tektronix 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 general operating information, a functional check procedure, and basic applications for this instrument.

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 the specifications given in Section 2.

To install the unit in a plug-in compartment, 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 Functional Check procedure in this section.

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

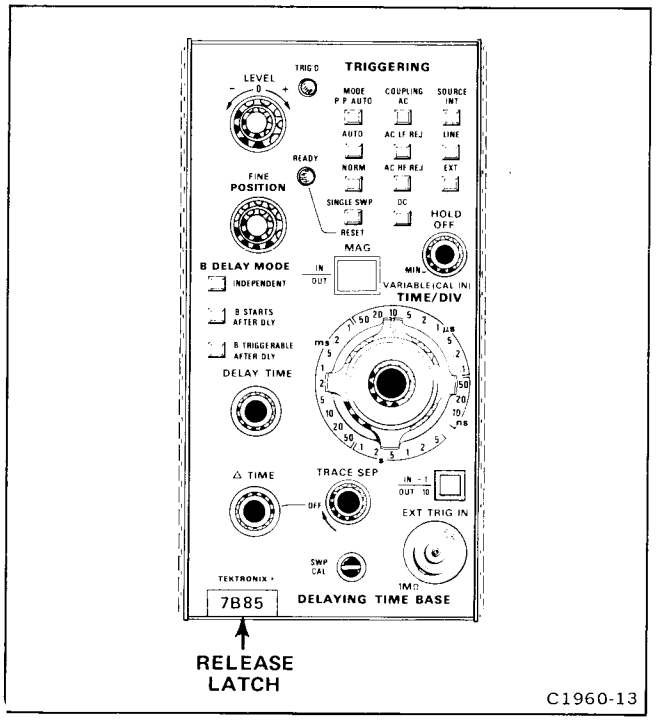

Fig. 1-1. Location of release latch.

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 1-2 shows and provides a brief description of all front-panel controls, connectors, and indicators. More detailed information is given in the General Operating Instructions.

FUNCTIONAL CHECK

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 improper adjustment, 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 7B85 in the A horizontal compartment of the mainframe.

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

3. Set the 7B85 controls as follows:

SLOPE	(+)
MODE	P-P 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 counter-clockwise)
MAG	X1 (pushed in)

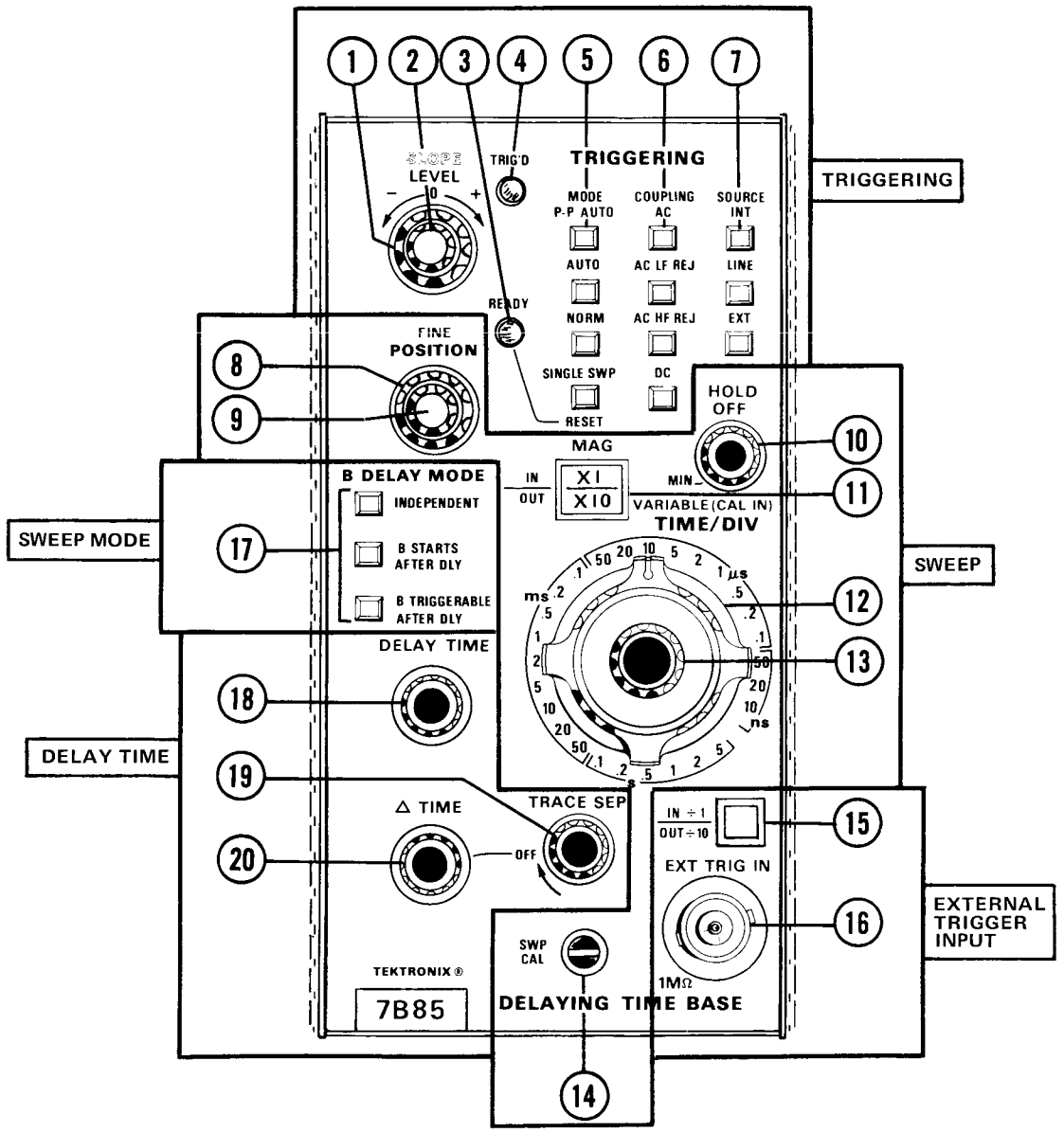

Fig. 1-2. Front-panel controls, connectors, and indicators.

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 SWEEP 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 7B85 may be used.

EXTERNAL TRIGGER INPUT

(15) EXT TRIG ATTENUATOR—Selects attenuation factor for external trigger signals.

(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 Δ TIME functions are activated. There will be a 2 division vertical shift of the trace when switching from INDEPENDENT to B STARTS AFTER DELAY.

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 Δ TIME functions and provides vertical separation of the delayed sweep traces (Δ TIME operation).

(20) Δ 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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Fig. 1-2. Front-panel controls, connectors, and indicators (cont.).

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 unit input.

3. Set the amplifier 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).

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 p-p 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 7B85 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.

Δ (DIFFERENTIAL) TIME. Perform the following procedure to obtain a Δ (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 Δ 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 Δ 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. Press the AUTO MODE button and 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 unit and to the EXT TRIG IN connector.

6. Press the EXT SOURCE button and set the amplifier 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 RESET MODE button is pressed.

13. Disconnect the mainframe calibrator signal from the amplifier unit input and press the RESET MODE 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 unit input.

GENERAL 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 series of push buttons. With this arrangement, a stable display can usually be obtained by pressing the top push buttons: P-P 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.

P-P AUTO. The P-P AUTO MODE provides a triggered display at any setting of the LEVEL control whenever an adequate trigger signal is applied. The range of the LEVEL control in the P-P AUTO MODE is between approximately 10% and 90% of the peak-to-peak amplitude of the trigger signal. The LEVEL control can be set so that the displayed waveform starts at any point within this range on either slope. The trigger circuits automatically compensate for a change in trigger signal amplitude. Therefore, if the LEVEL control is set to start the waveform display at a certain percentage point on the leading edge of a low-amplitude signal, it triggers at the same percentage point on the leading edge of a high-amplitude signal if the LEVEL control is not changed. When the trigger repetition rate is outside the parameter given in the Specification section, or when the trigger signal is inadequate, the sweep free runs at the rate indicated by the TIME/DIV switch to produce a bright base-line, reference trace (TRIG'D light off). When an adequate trigger signal is again applied, the free-running condition ends and a triggered display is presented.

The P-P AUTO MODE is particularly useful when observing a series of waveforms, since it is not necessary to reset the LEVEL control for each observation. The P-P AUTO MODE is used for most applications because of the ease of obtaining a triggered display. The AUTO, NORM, and SINGLE-SWP MODE settings may be used for special applications.

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).

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 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.

AC. 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.

AC LF REJ. AC LF REJ COUPLING rejects dc, and attenuates low-frequency trigger signals below about 30 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 line-frequency 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.

AC HF REJ. AC HF REJ COUPLING passes all low-frequency signals between about 30 hertz and 50 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.

DC. 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 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 ÷10 push button attenuates the external trigger signal by a factor of 10. Attenuation of high amplitude external trigger signals is desirable to increase the effective range of the LEVEL control.

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 Figure 1-3). 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.

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

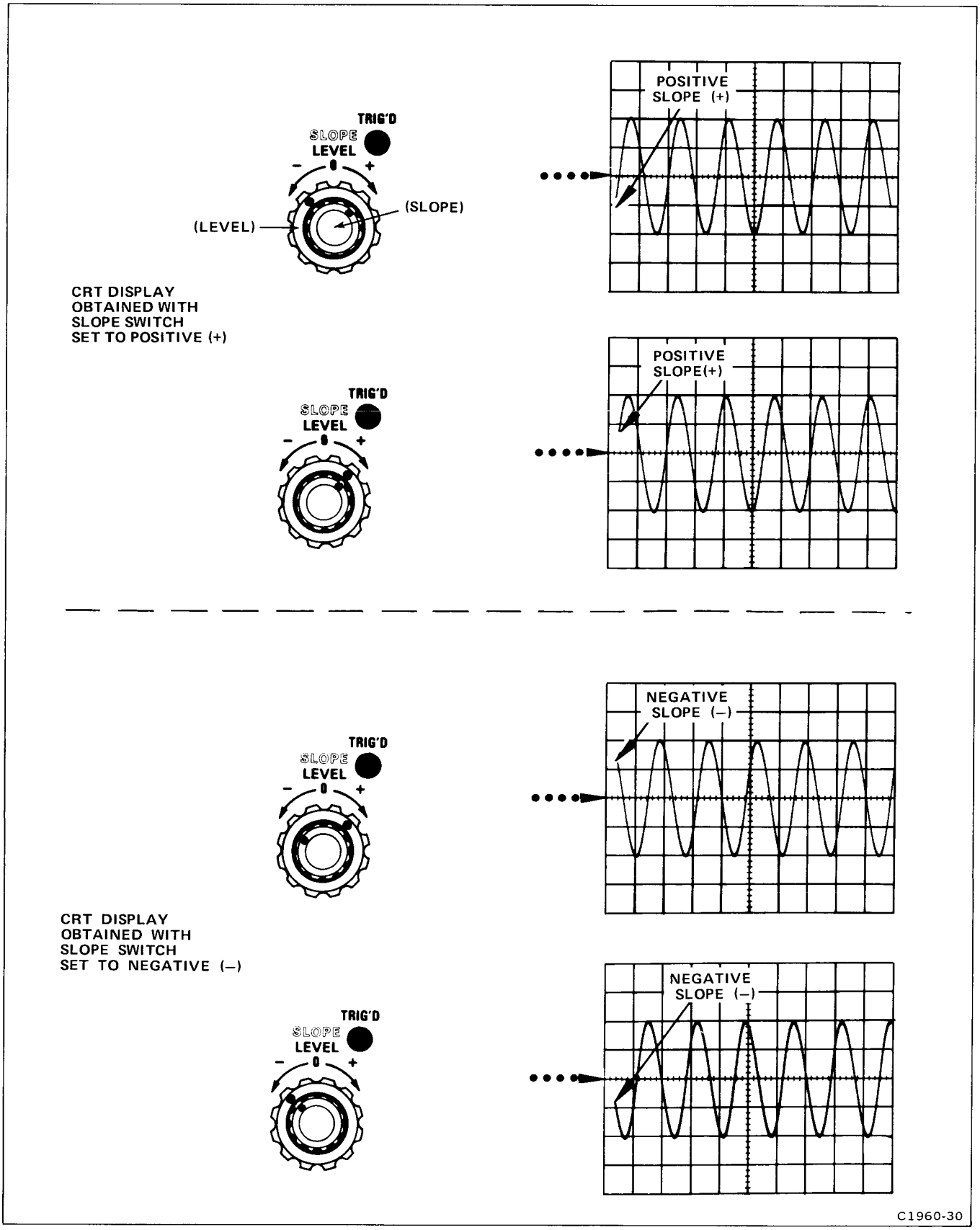

Fig. 1-3. Effects of LEVEL control and SLOPE switch on crt display.

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 1-3 illustrates this effect with different settings of the SLOPE switch.

To set the LEVEL control, first select 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.

Horizontal Sweep Rates

The TIME/DIV switch provides calibrated sweep rates from 5 seconds/division to 10 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 in 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 Figure 1-4). 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 form (see Figure 1-5). 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.

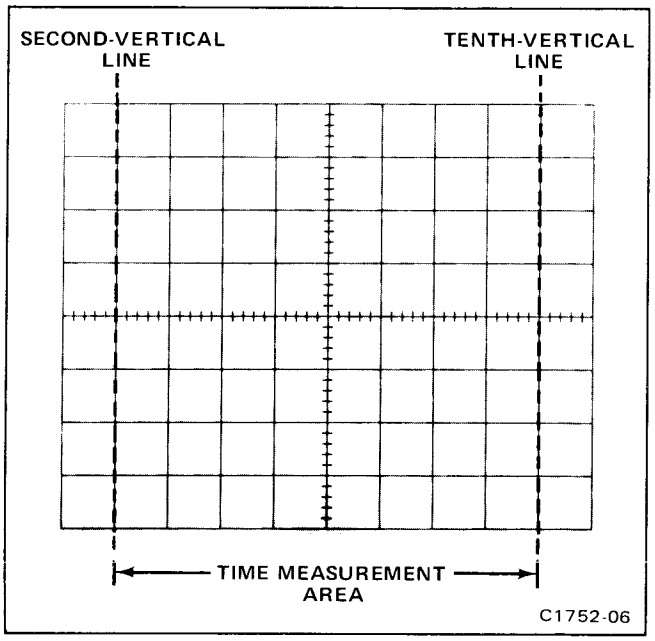

Fig. 1-4. Area of graticule used for most accurate time measurements.

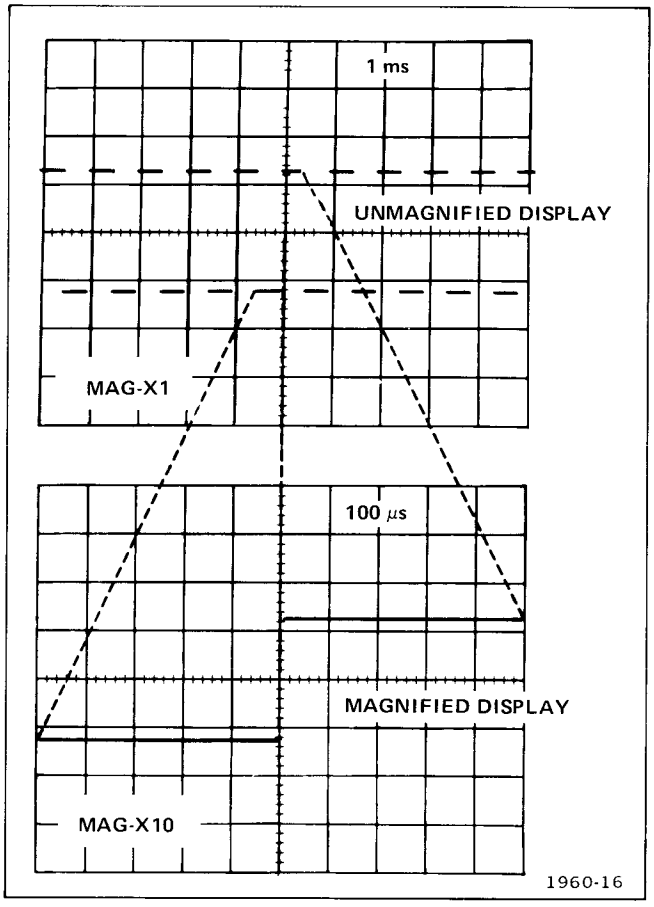

Fig. 1-5. Effect of sweep magnifier on crt display.

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 7B85 installed in the mainframe A horizontal compartment can delay a companion time-base unit installed in the B horizontal compartment. When operating the 7B85 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 companion time-base unit runs (see Figure 1-6). 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 Figure 1-6). 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 7B85 TIME/DIV switch and DELAY TIME control. The amount of calibrated delay time is displayed on the crt readout.

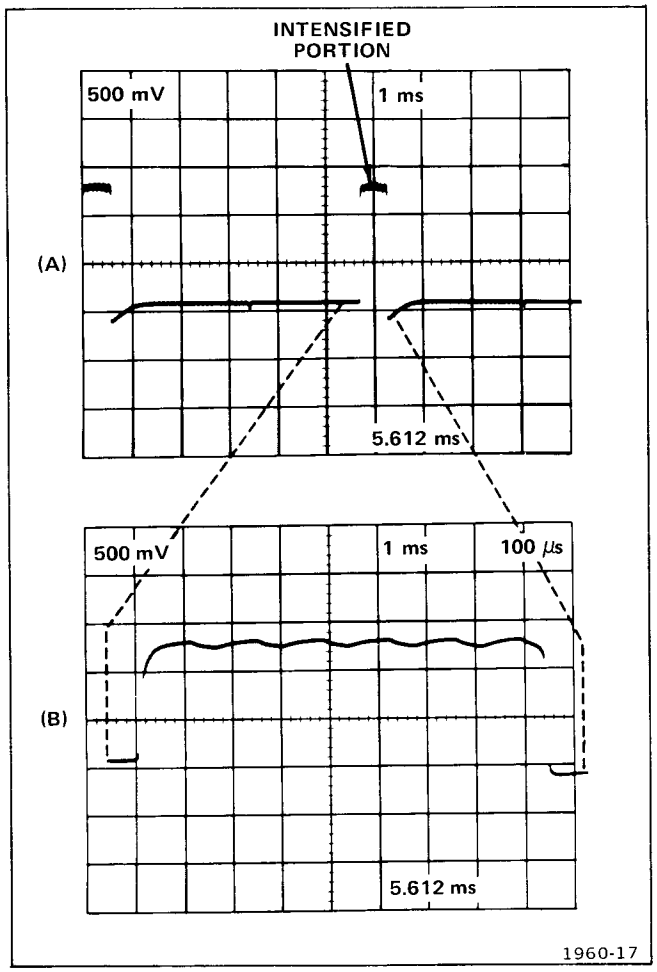

Fig. 1-6. (A) Delaying-sweep display produced by 7B85 in the A horizontal compartment. (B) Delayed-sweep display produced by companion time-base unit in the B horizontal compartment.

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 7B85 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 7B85 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.

Δ Time Operation

The Δ TIME delaying mode provides the best means of making differential time measurements. The 7B85 can delay a companion time-base unit at 2 separate delay times. At the end of the first delay time (determined by the 7B85 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 7B85 TIME/DIV switch, the DELAY TIME, and Δ TIME controls) a second intensified zone and corresponding second delayed-sweep trace are displayed (see Figure 1-7). The 7B85 must be installed in the

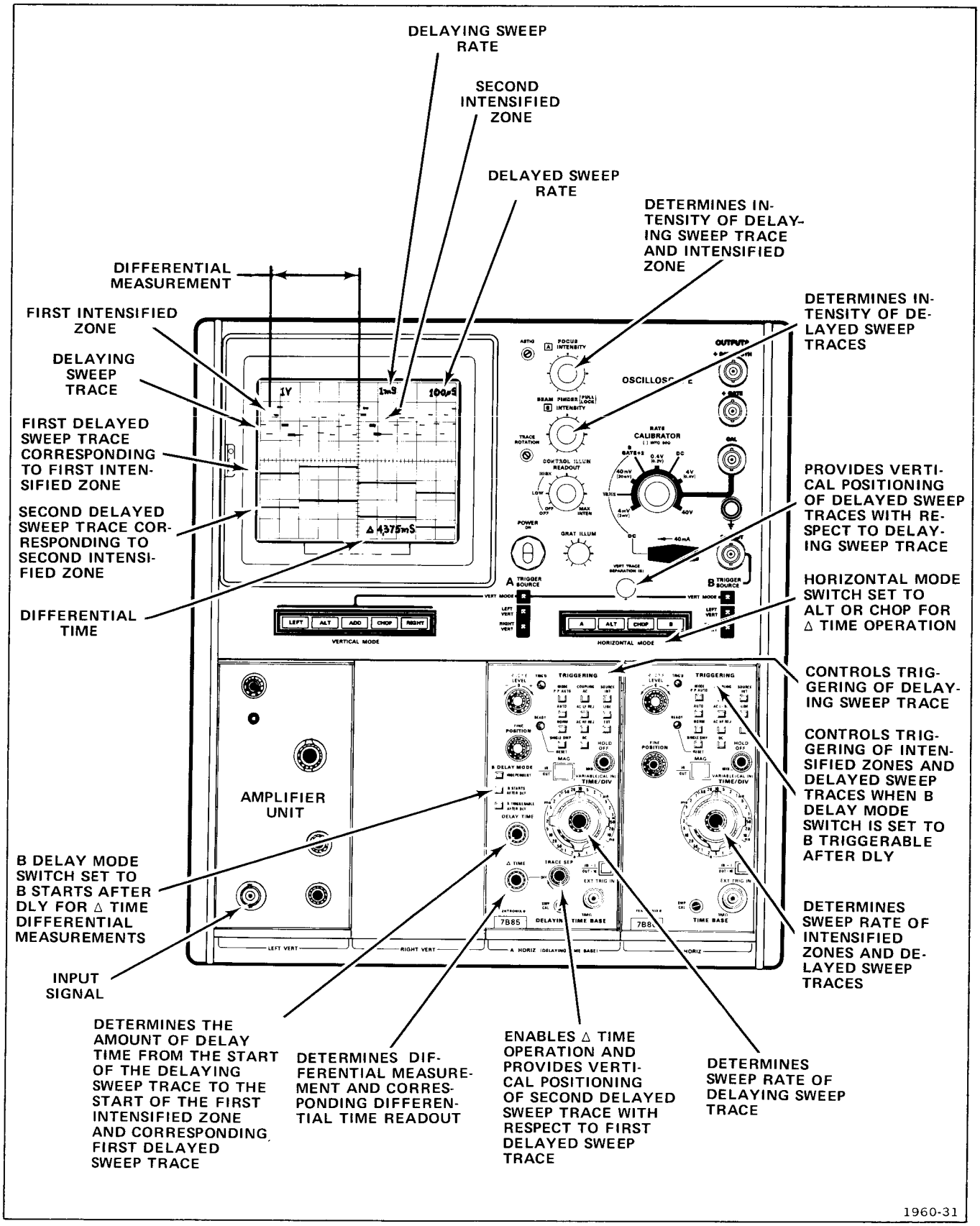

Fig. 1-7. Typical Δ (Differential) Time operation.

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 Δ TIME operation. The sweep rate for the delaying-sweep trace is determined by the 7B85 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 Figure 1-7). A Δ symbol preceding the delay-time readout indicates a differential measurement. The > (greater than) symbol following the Δ 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 traces with respect to the delaying-sweep trace is provided by the vertical separation control on the oscilloscope mainframe.

Δ TIME OPERATION IN A DUAL-BEAM OSCILLOSCOPE MAINFRAME. The 7B85 Δ TIME function is compatible with 7000-series dual-beam mainframes and operation is basically the same as given for Δ Time Operation. The 7B85 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 7B85 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 Δ 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 Δ TIME operation.

Mainframe Operating Modes

The 7B85 can also be operated either as an independent time base in any Tektronix 7700-, 7800-, and 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 7B85) is required for delayed-sweep operation. Refer to Applications in this section for additional information.

APPLICATIONS

The 7B85 is designed primarily for use with a companion time-base unit in a readout-equipped mainframe to make delayed-sweep time-interval measurements. The 7B85 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 Δ (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.

In the Δ (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 Δ TIME controls. The crt readout then indicates the differential (Δ) 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 (Δ 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 Δ (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 7B85 in the mainframe A horizontal compartment and a companion time-base unit in the B horizontal compartment.

2. Set the 7B85 controls as follows:

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

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

4. Set the mainframe for the A horizontal mode to display the 7B85, and the vertical mode to display the vertical 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 7B85 sweep rate for the desired display. See the example in Figure 1-8.

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 1-8).

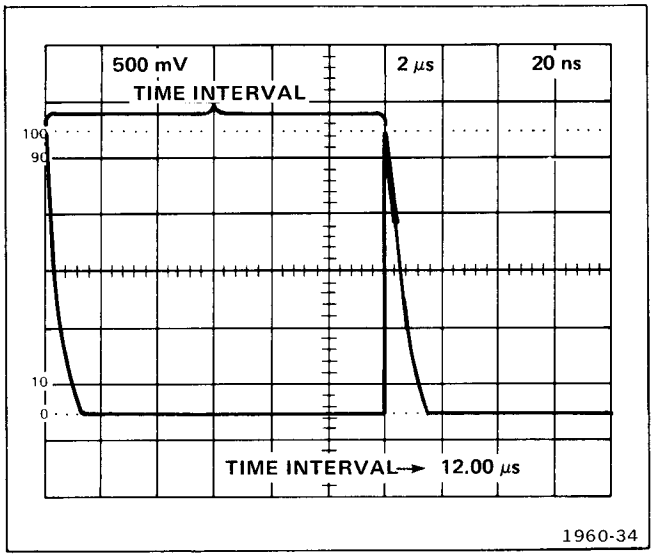

Fig. 1-8. Measuring time intervals from a triggering event (start of sweep) to any point on a waveform.

Differential Time-Interval Measurements (Δ 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 7B85 in the mainframe A horizontal compartment and a companion time-base unit in the B horizontal compartment.

2. Set the 7B85 controls as follows:

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

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

4. Set the mainframe for the A horizontal mode to display the 7B85 and the vertical mode to display the vertical unit.

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

6. Set the appropriate triggering, position, deflection-factor, and sweep-rate controls to obtain the desired display. See the examples in Figure 1-9.

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 Figure 1-9, point A).

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

9. Adjust the Δ TIME control to position the leading edge of the second intensified zone to the end of the time interval to be measured (see Figure 1-9, 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.

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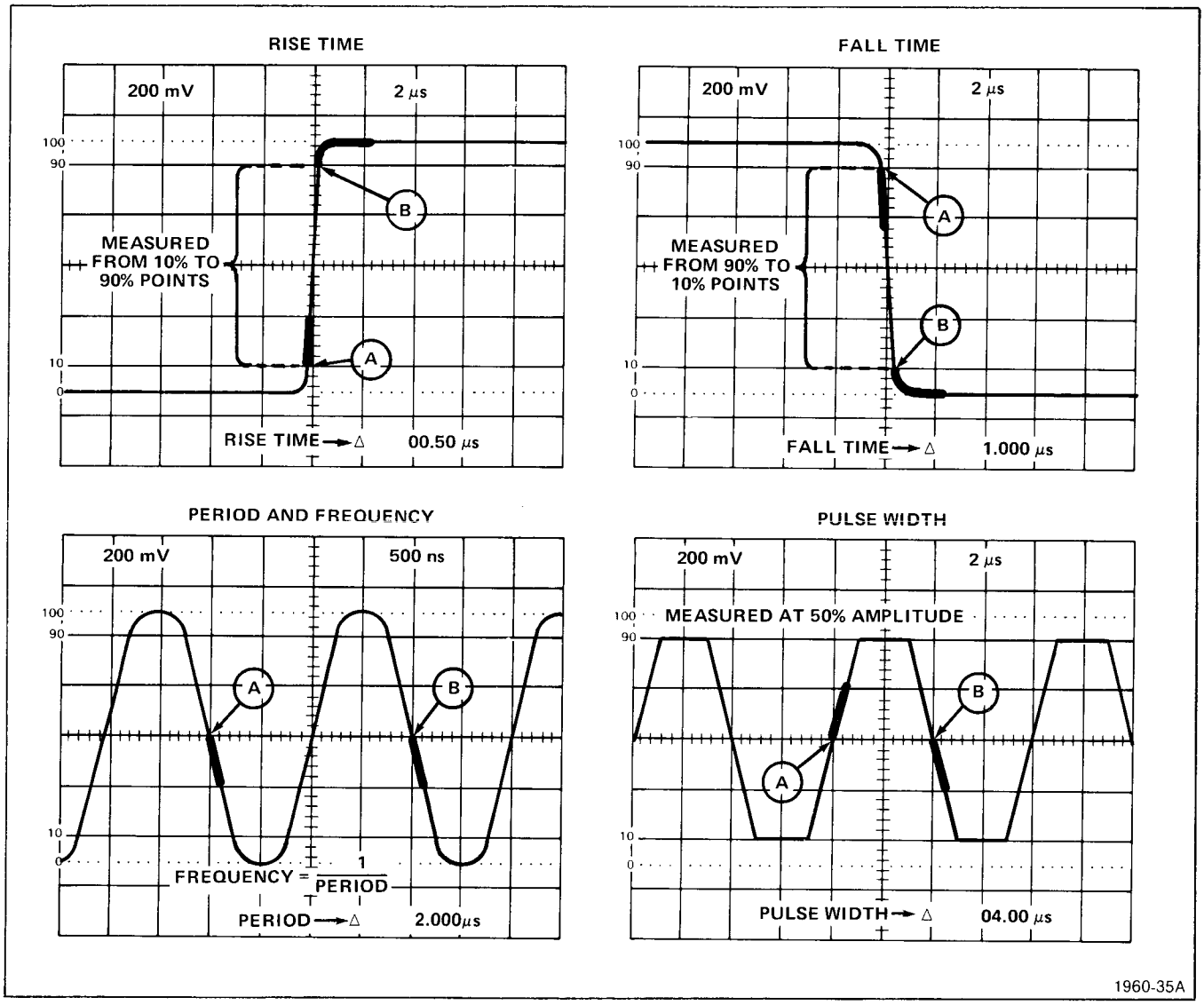

Fig. 1-9. Measuring rise time, fall time, period, frequency, or pulse width in the Δ (differential) time mode.

The following procedures use alternate or chopped horizontal (dual-trace) operation to: (1) 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 Δ (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 7B85 in the mainframe A horizontal compartment and a companion time-base unit in the B horizontal compartment.

2. Set the 7B85 controls as follows:

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

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

2. Set the 7B85 controls as follows:

B DELAY MODE	B STARTS AFTER DLY (button in)
MAG	X1 (button in)
HOLD OFF	MIN (fully counter-clockwise)
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 procedures 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 1-10.

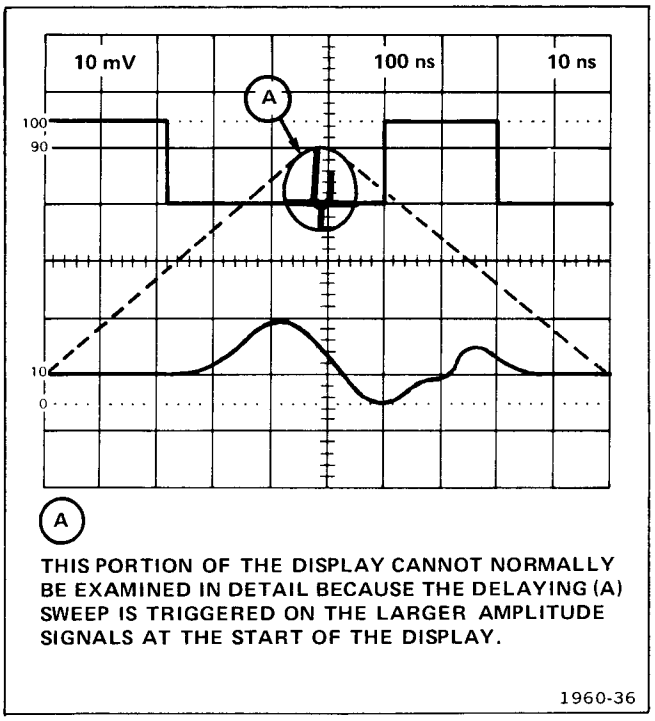

Fig. 1-10. Magnifying a selected segment of the delaying (A) sweep in the delay-time mode with mainframe alternate or chopped horizontal operation.

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 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 1-10.

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 7B85 TIME/DIV setting.

f. Determine apparent magnification by dividing the 7B85 TIME/DIV setting by the delayed (B) sweep unit sweep-rate setting.

Example: The apparent magnification of the delayed (B) sweep shown in Figure 1-10 with a 7B85 TIME/DIV setting of .1 millisecond and a delayed (B) sweep unit sweep-rate setting of 1 microsecond is:

$$\text{Apparent Magnification} = \frac{\text{7B85 TIME/DIV setting}}{\text{Delayed (B) Sweep Time/Div setting}}$$

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 Δ (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 Δ (differential) time measurements. For Δ (differential) time operation, the 7B85 TRACE SEP control must be turned counterclockwise out of the OFF (detent) position. The Δ 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 Δ (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 1-11.

NOTE

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

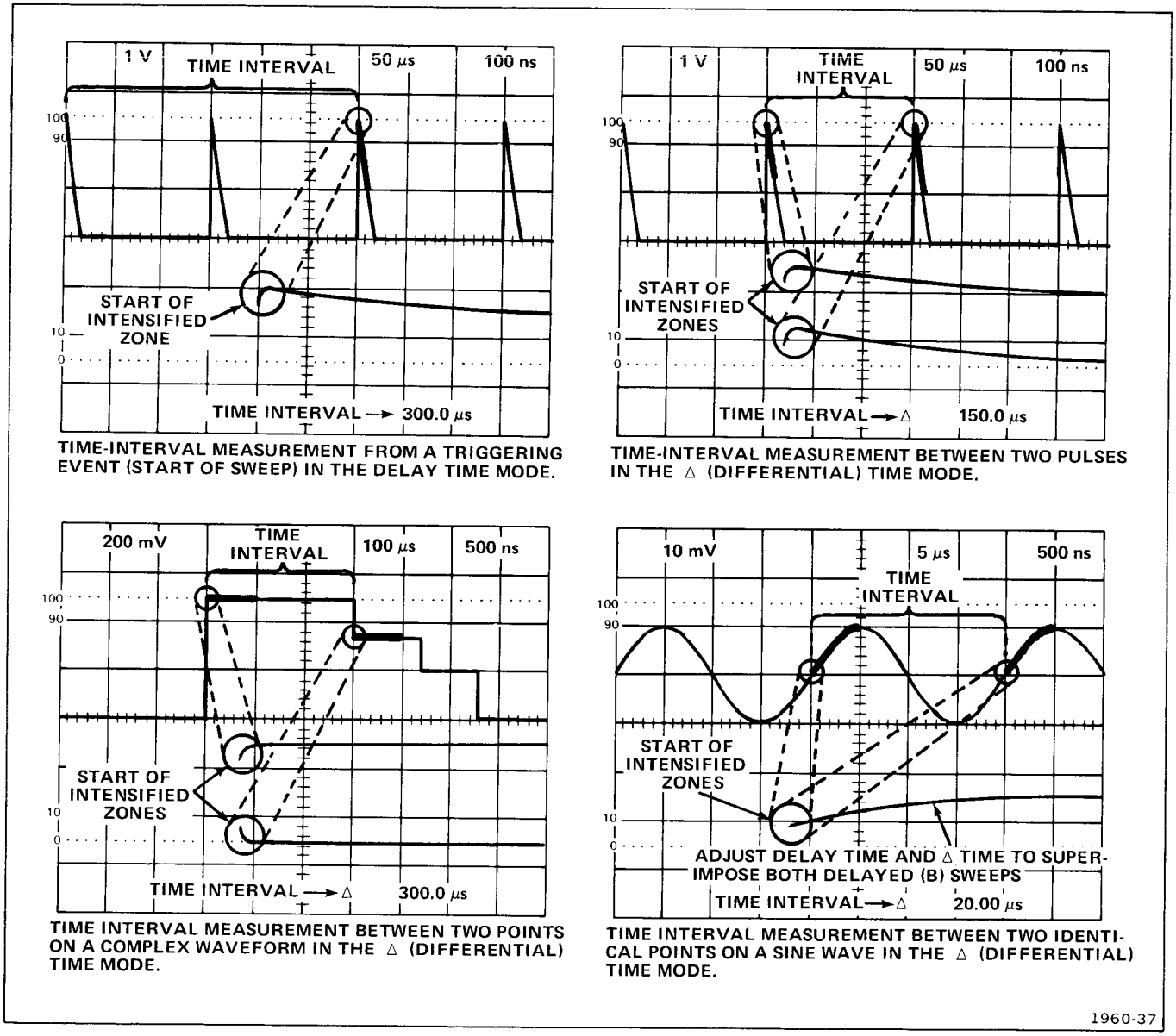

Fig. 1-11. Time-interval measurements in the delay-time and Δ (differential) time mode with mainframe alternate or chopped operation.

c. Turn the DELAY TIME (and Δ 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 1-11.

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 7B85 TIME/DIV setting.

e. 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 1-12.

NOTE

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

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 1-12.

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-unit deflection-factor to increase the display amplitude. Do not change the 7B85 TIME/DIV setting.

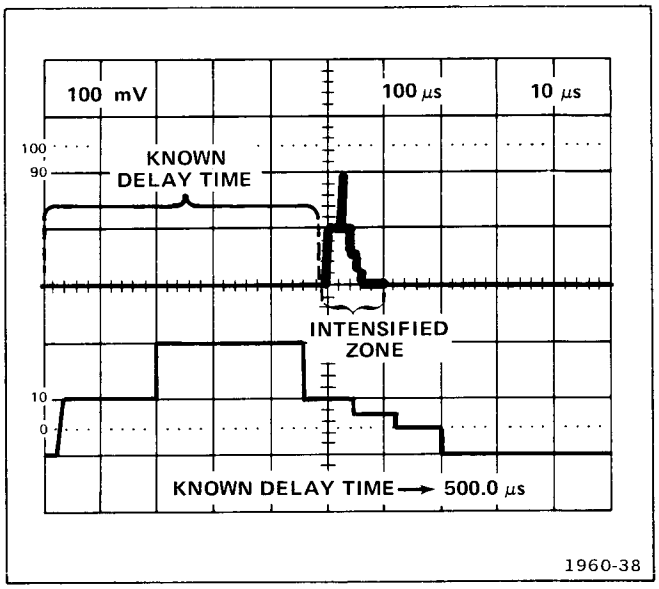

Fig. 1-12. Examining an event that occurs within a selected time interval after a known delay time in the delay-time mode.

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 7B85 is designed primarily for use with a companion time-base unit in 7700-, 7800-, or 7900-series oscilloscope mainframes with two horizontal compartments and crt readout. However, the 7B85 can also be used as an independent non-delaying time base (e.g., in a compatible mainframe with one horizontal compartment). To operate the 7B85 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.

SPECIFICATION

This instrument will meet the electrical characteristics listed in Table 2-1, following complete adjustment. The following electrical characteristics apply over an ambient temperature range of 0° to +50° C, except as otherwise indicated. Warmup time for given accuracy is 20 minutes.

TABLE 2-1
Electrical Characteristics

Characteristic	Performance Requirement			
SWEEP GENERATOR				
Sweep Rates				
Calibrated Range	5 s/div to 10 ns/div in 27 steps. X10 Magnifier extends fastest calibrated sweep rate to 1 ns/div.			
Variable Range	Continuously variable uncalibrated sweep rate to at least 2.5 times the calibrated sweep rate setting.			
Sweep Accuracy[1] (With 7700, 7800, or 7900-Series Mainframes)	With SWP CAL adjusted at 1 ms/div within the temperature range of +20° to +30° C to a timing reference of 0.25% or better.			
Over Center 8 Div	+15° to +35° C		0° to +50° C	
	Unmag	Mag	Unmag	Mag
5 s/Div to 1 s/Div	4.0%	5.0%	5.0%	6.0%
0.5 s/Div to 0.1 μs/Div	1.5%	2.5%	2.5%	3.5%
50 ns/Div to 10 ns/Div	2.5%	4.0%	3.5%	5.0%
Excluded Portions of Sweep				
Start of Sweep	First 10 ns in 7800, 7900-series mainframes. First 20 ns in 7700-series mainframes. First 50 ns in all other 7000-series mainframes.			
End of Sweep	Beyond 10th div unmagnified. Beyond 100th div magnified.			
Sweep Length (Unmagnified)	At least 10.2 div at all sweep rates.			
MAG Registration	0.5 div or less from graticule center when changing from MAG X10 to MAG X1.			
Position Range				
POSITION Controls Fully Clockwise	Start of sweep must be to the right of graticule center at 1 ms/div.			
POSITION Controls Fully Counterclockwise	End of sweep must be to the left of graticule center at 1 ms/div.			

[1] The fastest calibrated sweep rate is limited by some mainframes (oscilloscopes).

TABLE 2-1 (CONT.)
Electrical Characteristics

Characteristic	Performance Requirement
Trigger Holdoff Time	
Minimum Holdoff Setting	
5 s/Div to 1 μs/Div	2 times TIME/DIV setting or less.
0.5 μs/Div to 10 ns/Div	2.0 μs or less.
Variable Holdoff Range	Extends holdoff time through at least 2 sweep lengths for sweep rates of 20 ms/div or faster.
VARIABLE TIME DELAY	
Δ TIME	
Range	0.0 to at least 9.0 times TIME/DIV setting.
Accuracy (+15° to +35° C)	
0.5 s/Div to 50 ms/Div	Within (0.5% measurement +0.1% full scale +1 least significant digit).[2]
20 ms/Div to 100 ns/Div	Within (0.5% measurement +0.03% full scale +1 least significant digit).[2]
TRACE SEPARATION Range	Functional only in the Δ TIME mode when alternating or chopping between time-base units. The second delayed sweep display can be vertically positioned at least 3 div below the first delayed sweep display with mainframe Vertical Separation control centered.
DELAY TIME	
Range	0.2 or less to at least 9.0 times TIME/DIV setting.
Jitter	(0.002% of full scale + 0.1 ns) or less. (0.002% equals 1/50,000.)
Differential Measurement Accuracy (Measurement is made by subtracting 2 delay times from the crt readout) (+15° to +35° C)	
0.5 s/Div to 100 ns/Div	Derate Δ TIME specification by 1 additional least significant digit.
Start of Delayed Sweep Display (With respect to start of delaying sweep display) (+15° to +35° C)	
0.5 s/Div to 10 μs/Div	Within (0.5% of measurement + 0.5% full scale).[2]

[2] Full scale equals 10 times the TIME/DIV switch setting.

TABLE 2-1 (CONT.)
Electrical Characteristics

Characteristic	Performance Requirement		
TRIGGERING			
Triggering Sensitivity from Repetitive Signal (Auto, Norm and Single Sweep Modes)	**Triggering Frequency Range**[3]	**Minimum Triggering Signal Required**	
Coupling		**Internal**	**External**
AC	30 Hz to 50 MHz 50 MHz to 400 MHz	0.3 div 1.5 div	50 mV 250 mV
AC LF REJ[4]	30 kHz to 50 MHz 50 MHz to 400 MHz	0.3 div 1.5 div	50 mV 250 mV
AC HF REJ	30 Hz to 50 kHz	0.3 div	50 mV
DC[5]	Dc to 50 MHz 50 MHz to 400 MHz	0.3 div 1.5 div	50 mV 250 mV
Internal Trigger Jitter	0.1 ns or less at 400 MHz.		
External Trigger Input			
Maximum Input Voltage	250 V (dc plus peak ac).		
Input R and C	1 MΩ within 5%, 20 pF within 10%.		
Level Range (Excluding P-P AUTO)	(Checked on 1 kHz sine wave.)		
EXT ÷ 1	At least + and −1.5 volts.		
EXT ÷ 10	At least + and −15 volts.		
P-P AUTO Operation Sensitivity (Ac or Dc Coupling)	**Triggering Frequency Range**	**Minimum Triggering Signal Required**	
		Internal	**External**
	200 Hz to 50 MHz	0.5 div	125 mV
	50 MHz to 400 MHz	1.5 div	375 mV
Low Frequency Response	At least 50 Hz	2.0 div	500 mV

[3] The triggering frequency ranges given here are limited to the −3 dB frequency of the oscilloscope vertical system (mainframe and amplifier unit) when operating from an internal source.
[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 applies to frequencies above 30 Hz when operating in the AUTO TRIGGERING MODE.

TABLE 2-2
Environmental Characteristics

Refer to the Specification section of the associated mainframe manual.

TABLE 2-3
Physical Characteristics

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

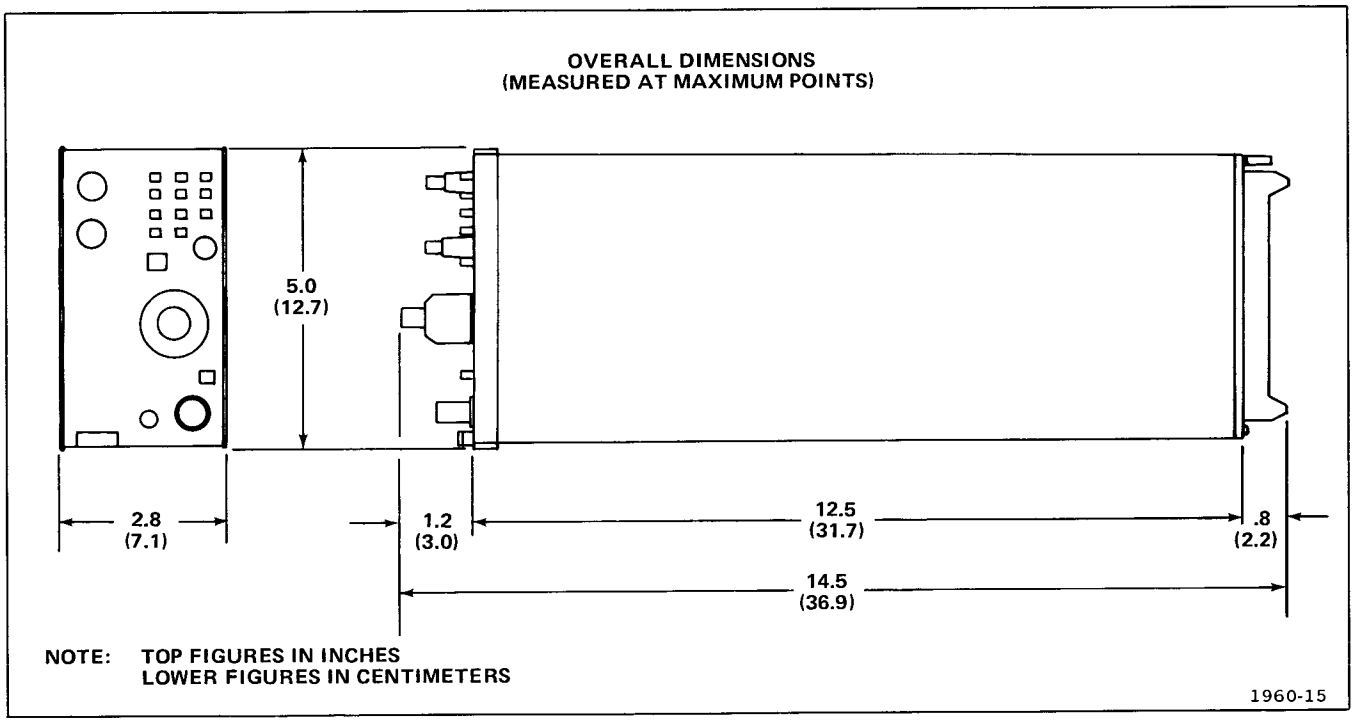

Fig. 2-1. 7B85 dimensional drawing.

STANDARD ACCESSORIES

1 ea . . . . . .Operators Manual

1 ea . . . . . .Instruction Manual

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INSTRUMENT OPTIONS

No options were available for this instrument at the time of this printing.

Information on any subsequent options may be found in the CHANGE INFORMATION section in the back of this manual.

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.