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

7B10
TIME BASE

OPERATORS

INSTRUCTION MANUAL

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

070-2317-00
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

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OPERATORS SAFETY SUMMARY

The following general safety information applies to all operators and service personnel. Specific warnings and cautions will be found throughout the manual where they apply and should be followed in each instance.

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

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

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 REMOVE INSTRUMENT COVERS

To avoid electric-shock hazard, operating personnel must not remove the protective instrument covers. Component replacement and internal adjustments must be made by qualified service personnel only.

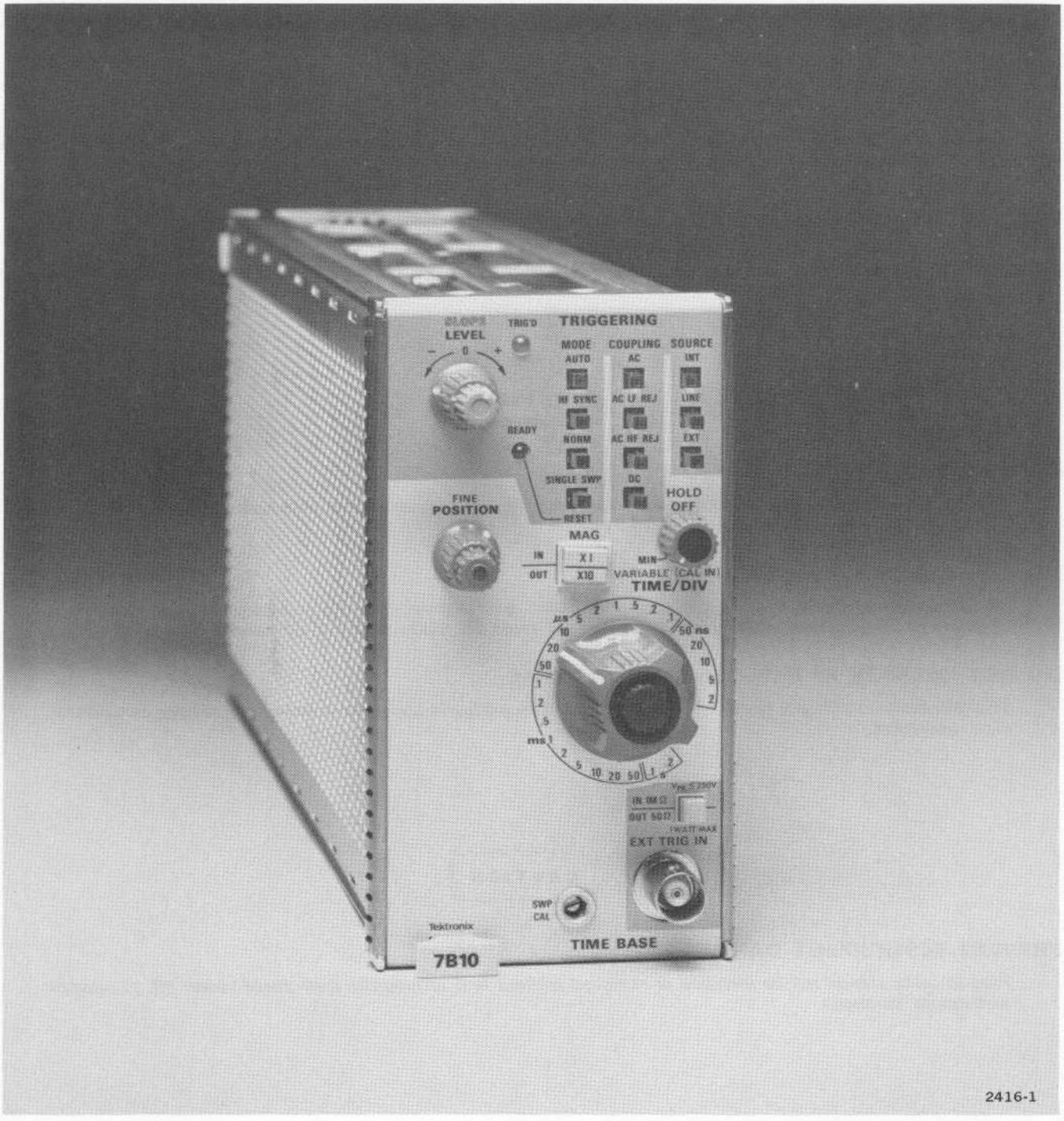
DO NOT OPERATE IN EXPLOSIVE ATMOSPHERE

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

CAUTION

PREVENT INSTRUMENT DAMAGE

Plug-in units should not be installed or removed without first turning the instrument power off, to prevent instrument damage.



7B10 Features

The 7B10 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. A X10 Magnifier increases each sweep rate by a factor of 10 and a VARIABLE TIME/DIV control provides 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. The 7B10 can be operated as an independent time base or as a delayed-sweep unit with a companion delaying time-base unit.

GENERAL INFORMATION

INTRODUCTION

OPERATORS MANUAL

The Operators Manual contains information necessary to effectively operate the 7B10 Time Base and is divided into three sections: Section 1 provides a basic description of the 7B10 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 7B10 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 list 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, 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 can be saved and used for this purpose. If more information is needed, contact your local Tektronix Field Office or representative.

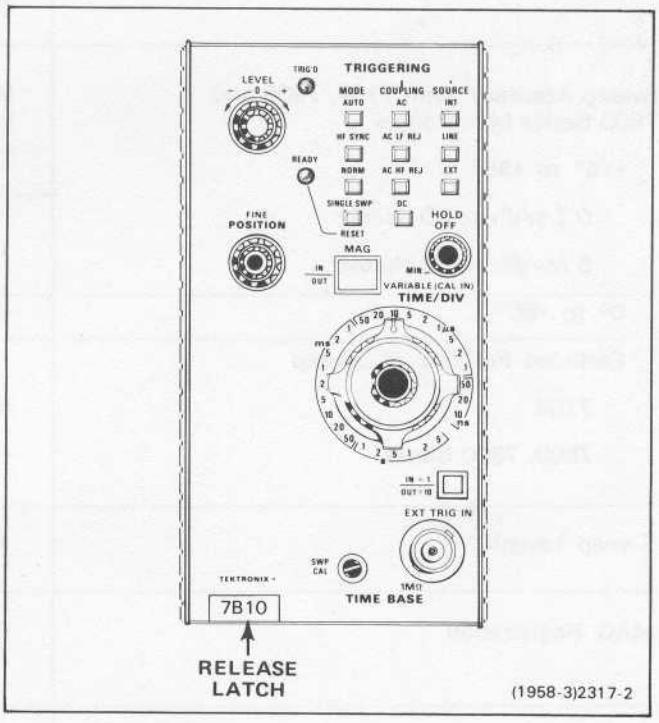


Fig. 1-1. Location of release latch.

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. [2] SWP CAL is adjusted at 1 ms/div within the +20° to +30° C range.	
+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 withir. the center 8 divisions.

TABLE 1-1 (CONT.)
Electrical Characteristics

Characteristic	Performance Requirement		
TRIGGERING			
Trigger Sensitivity for Repetitive Signals	Triggering Frequency Range[3]	Minimum Triggering Signal Required	
Coupling		Internal	External
AC	30 Hz to 250 MHz 250 MHz to 1 GHz	0.5 div 1.5 div	50 mV 150 mV
AC LF REJ[4]	50 kHz to 250 MHz 250 MHz to 1 GHz	0.5 div 1.5 div	50 mV 150 mV
AC HF REJ	30 Hz to 30 kHz	0.5 div	50 mV
DC[5]	DC to 250 MHz 250 MHz to 1 GHz	0.5 div 1.5 div	50 mV 150 mV
Single Sweep	Same as for Repetitive 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 75 mV External.		
External Trigger Input			
LEVEL RANGE	At least ±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	50 Ω within 2%.		
Trigger Holdoff Time			
Minimum Holdoff Setting			
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			
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		

[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 applies to frequencies above 30 Hz when operating in the AUTO TRIGGERING MODE.

TABLE 1-2

Environmental Characteristics

Refer to the Specification section of the associated mainframe manual.

TABLE 1-3

Physical Characteristics

Characteristic	Information
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

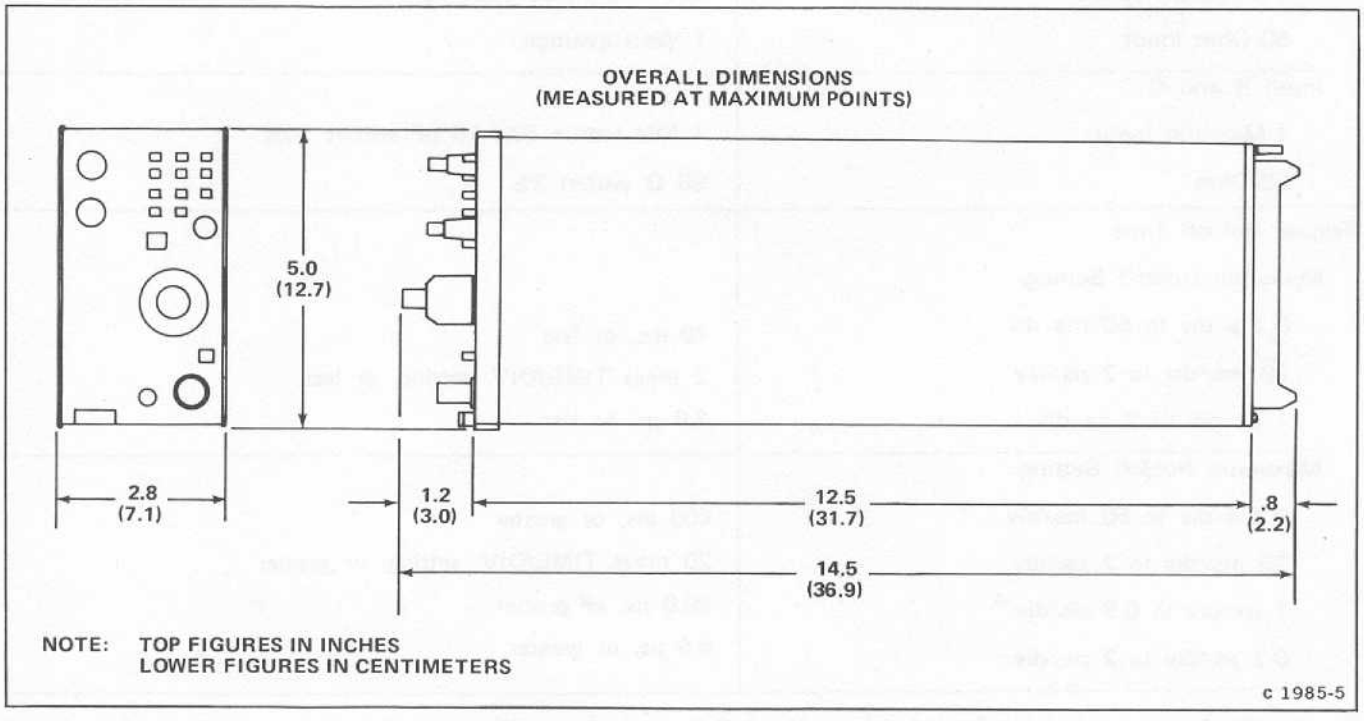


Fig. 1-2. 7B10 dimensional drawing.

OPERATING INSTRUCTIONS

The 7B10 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.

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 operators checkout 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 time-base unit being checked in the A horizontal compartment of the mainframe.

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

3. Set the time-base unit controls as follows:

SLOPE	(+)
MODE	AUTO
COUPLING	AC
SOURCE	INT
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 mainframe 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).

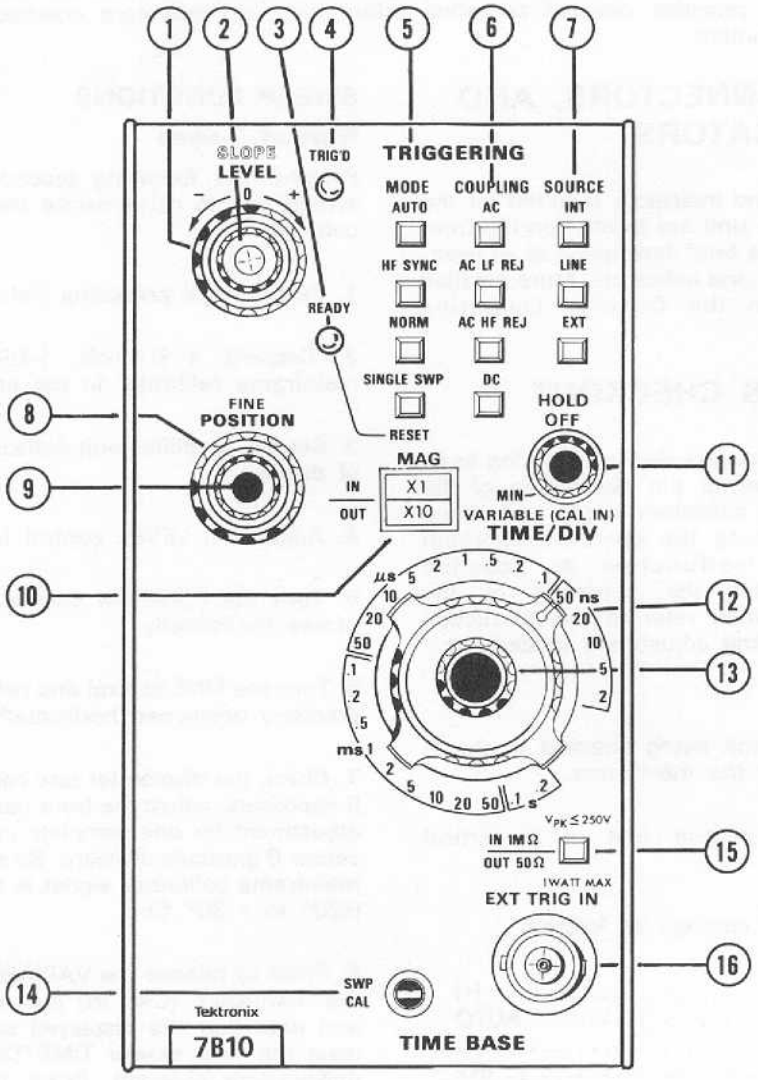


Fig. 2-1. Front-panel controls, connectors, and indicators.

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 circuit.

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

(11) HOLD OFF Control—Permits hold off period to be varied to improve trigger stability on repetitive complex waveforms.

(12) TIME/DIV Selector—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.

EXTERNAL TRIGGER INPUT

(15) EXT TRIG Button—Selects input impedance.

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

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

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 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).

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 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 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 MODE

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 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 settings 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.

TRIGGERING 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 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 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 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.

DC

DC COUPLING can be used to provide stable triggering from low-frequency signals which would be attenuated in the 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.

TRIGGERING 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.

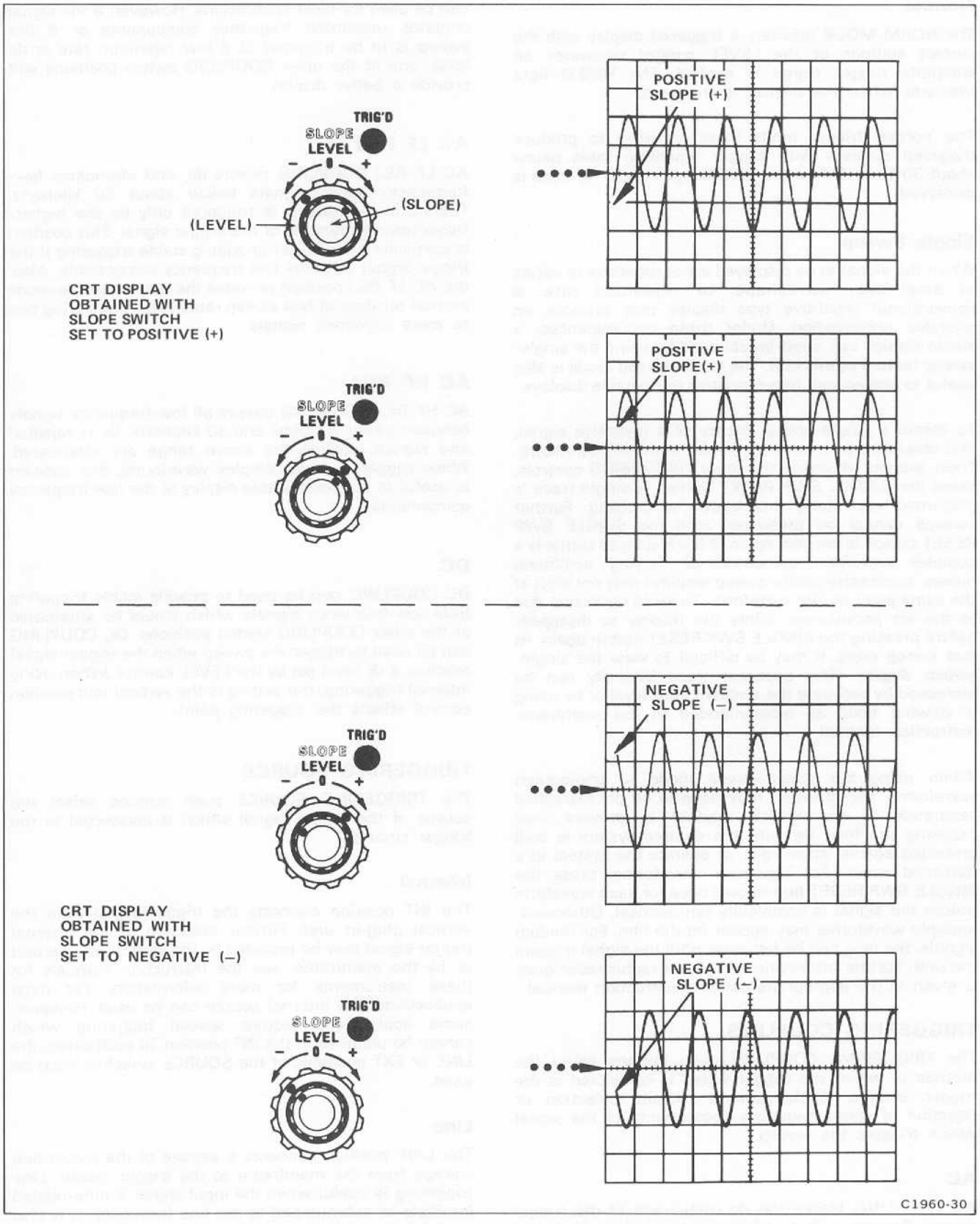

Fig. 2-2. Effect of LEVEL control and SLOPE switch on crt display.

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 1 MΩ/OUT 50 Ω pushbutton 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 50 Ω input impedance.

TRIGGERING 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, display starts on the positive-going portion of the waveform (see Figure 2-2). When several cycles of a signal appear on the display the setting of the SLOPE switch is often unimportant. However, if only a certain portion of a cycle is to be displayed, correct setting of the SLOPE switch is important to provide a display that starts on the desired slope of the input signal.

TRIGGERING 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 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.

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 .2 seconds/division to 2 nanosecond/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 MEASUREMENTS

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.

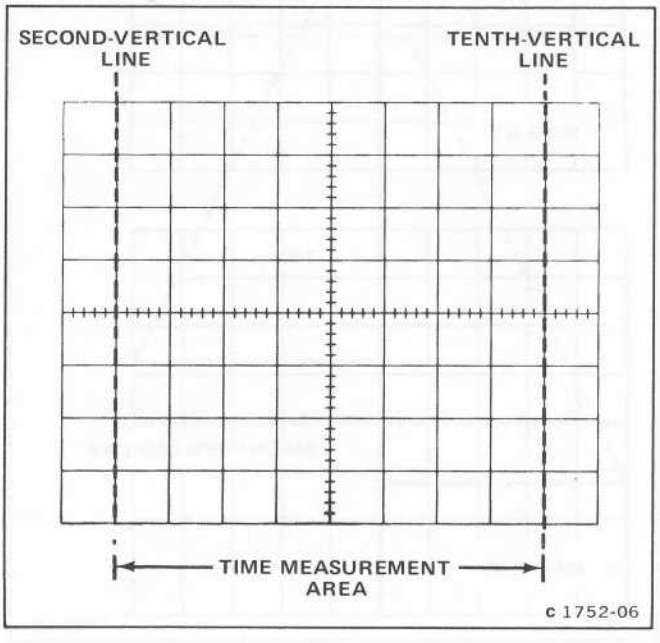

Fig. 2-3. Area of graticule used for most accurate time measurements.

SWEEP MAGNIFICATION

The sweep magnifier can be used to expand the display be a factor of 10. The center division of the unmagnified display is the portion visible on the crt in the magnified 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 carried 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.

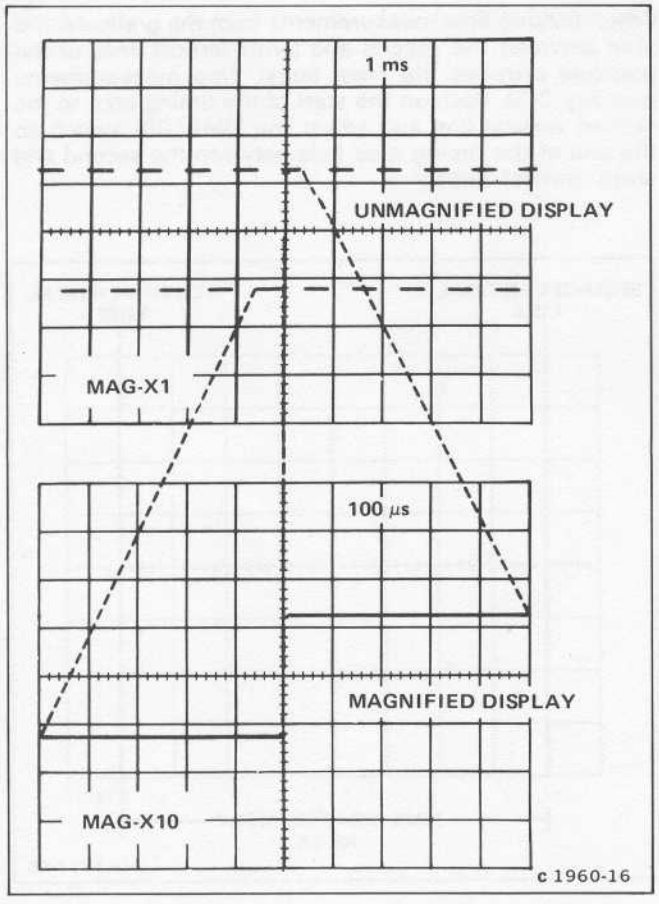

Fig. 2-4. Operation of sweep magnifier.

MAINFRAME OPERATING MODES

The time-base unit can be operated either as an independent time base in any Tektronix 7100-, 7700-, 7800-, or 7900-series oscilloscope mainframes, or as a delayed-sweep unit in those mainframes that have two horizontal compartments. A companion delaying time base unit is required for delayed-sweep operation. Refer to the delaying time-base unit instruction manual for additional information.

APPLICATIONS

The following information describes procedures and techniques for making basic time measurements with the time-base unit installed in a Tektronix 7100, 7700, 7600, or 7900-series oscilloscope. These procedures provide enough detail to enable the operator to adapt them to other related time measurements. Contact your Tektronix Field Office or representative for assistance in making measurements that are not described in this manual.

TIME-INTERVAL MEASUREMENTS

Since time is a function of the sweep rate and the horizontal distance (in divisions) that the sweep travels across the graticule in a calibrated-sweep oscilloscope system, the time interval between any two points on a waveform can be accurately measured. The following procedures provide methods to measure some of the more common time-related definable characteristics of a waveform such as period, frequency, rise time, fall time, and pulse width. The procedure for each of these measurements is essentially the same, except for the points between which the measurements are made. The time interval between any two selected points on a displayed waveform can be measured with basically the same technique.

PERIOD AND FREQUENCY MEASUREMENTS

Perform the following procedure to measure the period and determine the frequency of a displayed waveform:

1. Install the time-base unit in a mainframe horizontal compartment (either A or B horizontal in a four-compartment mainframe).

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

3. Set the mainframe horizontal- and vertical-mode switches to display the time base and vertical units. (Check that the time base VARIABLE (CAL IN) control is pushed in and the HOLD OFF control is in the MIN position.)

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

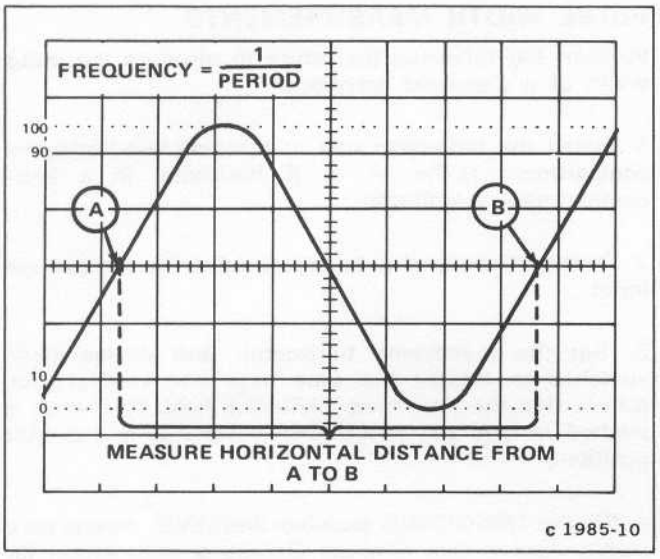

Fig. 2-5. Measuring the period and determining the frequency of a displayed waveform.

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

6. Set the TIME/DIV switch and POSITION controls for a complete cycle displayed within the center 8 graticule divisions as shown in Figure 2-5.

7. Measure the horizontal distance in divisions over 1 complete cycle of the displayed waveform.

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

Example: Assume that the horizontal distance over 1 complete cycle is 7 divisions, and the TIME/DIV switch setting is .1 ms (see Fig. 2-5).

Using the formula:

$$\text{Period} = \frac{\text{Horizontal distance} \times \text{TIME/DIV setting}}{\text{Magnification}}$$

Substituting values:

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

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

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

Using the formula:

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

Substituting values:

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

RISE-TIME AND FALL-TIME MEASUREMENTS

Perform the following procedure to measure the rise time and fall time of a displayed waveform:

1. Install the time-base unit in a mainframe horizontal compartment (either A or B horizontal in a four-compartment mainframe).

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

3. Set the mainframe horizontal- and vertical-mode switches to display the time base and the vertical unit. (Check that the time base VARIABLE (CAL IN) control is pushed in and the HOLD OFF control is in the MIN position.)

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

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

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

7. Determine rise time or fall time by measuring the horizontal distance in divisions between the point on the rising or falling portion of the waveform that is 10% and the point that is 90% of the total display amplitude (see Fig. 2-6).

NOTE

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

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

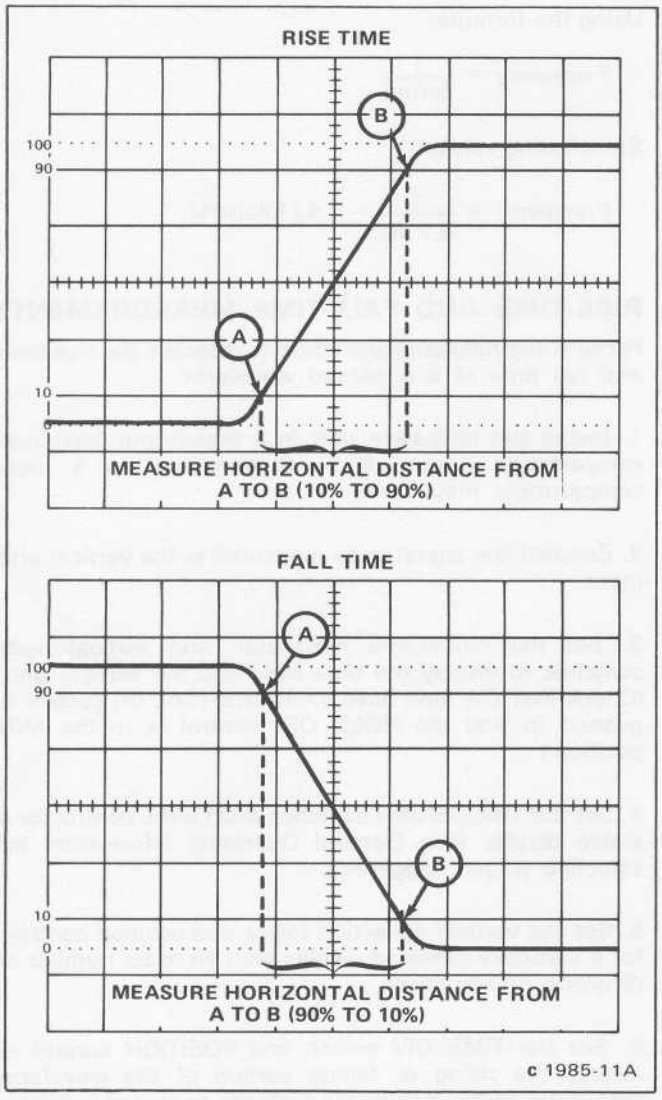

Fig. 2-6. Measuring the rise time and fall time of a displayed waveform.

Example: Assume that the horizontal distance between the 50% amplitude points is 3 divisions, and the TIME/DIV switch setting is .1 μs (see Fig. 2-6).

Using the formula:

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

Substituting values:

$$\text{Rise Time} = \frac{2.5 \times 0.1\ \mu s}{1} = 0.25 \text{ microsecond}$$

PULSE WIDTH MEASUREMENTS

Perform the following procedure to measure the pulse width of a displayed waveform:

1. Install the time-base unit in a mainframe horizontal compartment (either A or B horizontal in a four-compartment mainframe).

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

3. Set the mainframe horizontal- and vertical-mode switches to display the time base and vertical unit. (Check that the time base VARIABLE (CAL IN) control is pushed in and the HOLD OFF control is in the MIN position.)

4. Set the TRIGGERING switches and LEVEL control for a stable display (see General Operating information for selecting proper triggering).

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

6. Set the TIME/DIV switch and POSITION control for 1 complete pulse displayed within the center 8 graticule divisions as shown in Figure 2-7.

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

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

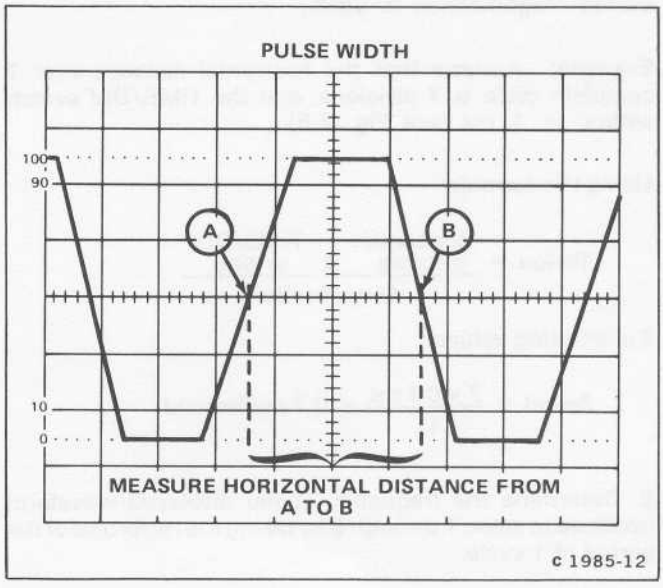

Fig. 2-7. Measuring the pulse width of a displayed waveform.

Example: Assume that the horizontal distance between the B amplitude points is 3 divisions, and the TIME/DIV switch setting is .1 ms (see Fig. 2-7).

Using the formula:

$$\text{Pulse Width} = \frac{\text{Horizontal distance} \times \text{TIME/DIV setting}}{\text{Magnification}}$$

Substituting values:

$$\text{Pulse Width} = \frac{3 \times 0.1 \text{ ms}}{1} = 0.3 \text{ millisecond}$$

DELAYED-SWEEP MEASUREMENTS

The time-base unit may be used with a delaying time-base unit in a mainframe with two horizontal compartments to make delayedsweep measurements. See the Tektronix Products Catalog for compatible delaying time-base plug-in units. If a compatible delaying time-base unit is available, refer to the instruction manual for that unit for detailed delayed-sweep measurement procedures.

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.