# INSTRUCTION MANUAL

Serial Number _____

# 5B12N
# DUAL TIME BASE

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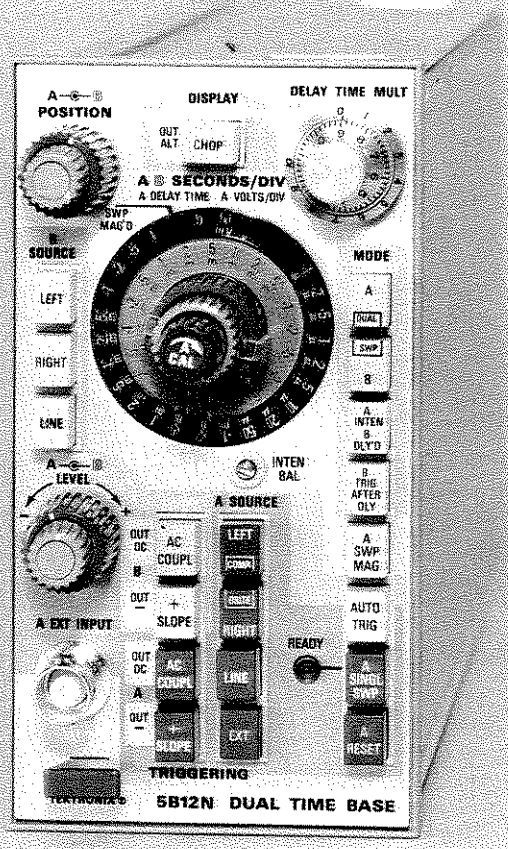

A B POSITION
DISPLAY
OUT ALT CHOP
DELAY TIME MULT
A B SECONDS/DIV
A DELAY TIME A VOLTS/DIV
SWP MAG'D
B SOURCE
LEFT
RIGHT
LINE
MODE
A
DUAL
SWP
B
A INTEN B DLY'D
B TRIG AFTER DLY
A SWP MAG
AUTO TRIG
A B LEVEL
INTEN BAL
A SOURCE
OUT DC B AC COUPL
OUT + − SLOPE
A EXT INPUT
READY
OUT DC A AC COUPL
OUT + − SLOPE
LEFT
CHOP
RIGHT
LINE
EXT
SINGLE SWP
A RESET
TRIGGERING
TEKTRONIX
5B12N DUAL TIME BASE

# SECTION 1
# OPERATING INSTRUCTIONS

## Instrument Description

The 5B12N Dual Time Base is a dual-sweep plug-in for use with Tektronix 5100-Series Oscilloscopes. The plug-in features two time-base generators, and is capable of producing two independent sweeps or a delayed sweep. The A Sweep time base provides normal sweep rates from 1 microsecond/division to 5 seconds/division; a 10 times magnifier extends the displayed sweep time/division to 100 nanoseconds. The B Sweep provides sweep rates from 0.2 microsecond/division to 0.5 second/division. The plug-in also accepts external signals to be displayed in lieu of the A Sweep. An illuminated knob skirt provides direct readout of the sweep rates and deflection factors.

## CONTROLS AND CONNECTORS

This is a brief description of the function or operation of the front-panel controls and connectors. More detailed information is given under General Information.

DISPLAY — Applies logic levels to the oscilloscope system to select Chop (button pushed in) or Alternate (button out) time-shared switching between vertical plug-ins and amplifier channels.

MODE

A: Selects A Time Base as the oscilloscope time base. B Time Base is locked out.

B: Selects B Time Base as the oscilloscope time base. A Time Base is locked out.

DUAL SWEEP (both the A and B buttons pushed in): Selects time-shared switching between the A and B time bases. If both vertical plug-ins are active, the A Time Base is slaved to the left vertical plug-in and the B Time Base is slaved to the right vertical plug-in.

A INTEN—B DLY'D (this button is dependent upon the A and B buttons): Button in permits display of the A Time Base, with the B Time Base operating concurrently and appearing as an intensified segment (the A button must be pressed in), or it permits display of the B Time Base, starting after a delay time established by the setting of the A SECONDS/DIV switch and the DELAY TIME MULT dial (the B button must be pressed in), or display is presented with the A sweep being intensified and the B sweep being delayed (both the A and B buttons must be pressed in).

B TRIG AFTER DELAY: Permits the B Time Base to be triggered after a delay time established by the setting of the A SECONDS/DIV switch and the DELAY TIME MULT dial.

AUTO TRIG: If triggering signal is absent or occurs at a rate less than 15 hertz, the sweep generators revert to a free-running mode (bright baseline). Button out selects Normal Triggered Mode. Displayed time base depends on DISPLAY MODE selected.

A SINGL SWP: Button in selects the Single Sweep Mode, allowing the A Time Base to be triggered only once until manually reset. Button out permits repetitive A sweep.

A RESET: Resets sweep circuits to accept next trigger when in the Single Sweep Mode. Terminates sweep if in process in any sweep mode.

READY INDICATOR — Indicates when the A sweep circuit is triggerable in Single Sweep Mode.

DELAY TIME MULT — Provides variable B-sweep delay between 0.20 and 10.20 times the delay time indicated by the A

SECONDS/DIV switch (delayed sweep modes only).

INTEN BAL — Balances intensity of traces produced by A and B time bases.

## A Time Base

A POSITION — Positions trace or display associated with the A Time Base.

A SECONDS/DIV

Time Base Mode — Time per major graticule division. Selects calibrated sweep rates from 1 μs/Div to 5 s/Div; 21 steps in a 1-2-5 sequence. Also selects the basic delay time (to be multiplied by the DELAY TIME MULT dial setting for delayed sweep operation). Variable Seconds/Div must be in calibrated position for indicated sweep rate or delay time. Knob skirt is illuminated to provide direct readout of sweep rate or basic delay time.

Amplifier Mode — Volts per major graticule division. Selects either of two calibrated deflection factors, 50 mV/Div or .5 V/Div for external voltage signals. Variable control must be in calibrated position and SWP MAG button must be out for correct deflection factor readout.

Variable Seconds/Div or Volts/Div — Provides uncalibrated, continuously variable sweep rate of deflection factor calibrated steps. It extends sweep rate range to 12.5 s/Div, or deflection factor range to 5 V/Div.

A SWP MAG — Provides X10 magnification of the sweep; extends displayed sweep per division to 100 nanoseconds/division. Knob-skirt illumination changes to SWP MAG'D so magnified sweep can be read directly.

A TRIGGERING SOURCE

LEFT: Selects the left vertical plug-in as the triggered-signal source for the A Time Base.

RIGHT: Selects the right vertical plug-in as the trigger-signal source for the A Time Base.

COMPOSITE: (both the LEFT and RIGHT buttons pushed in): Selects the signal or signals being displayed as the trigger-signal source for the A Time Base.

LINE: Selects line-frequency voltage as the trigger-signal source for the A Time Base.

EXT: Selects EXT INPUT as the trigger-signal source for the A Time Base.

A TRIGGERING LEVEL — Selects level of the triggering signal at which the sweep trigger is initiated.

A TRIGGERING COUPLING/SLOPE

AC COUPL: Button pushed in selects AC (capacitive) coupling of triggering and external signals. Button out selects DC coupling of the triggering and external signals.

+ SLOPE: Button pushed in selects the positive slope of the triggering signal; button out selects the negative slope.

EXT INPUT — Provides input for external A trigger or signal input for external signals.

## B Time Base

B POSITION — Positions trace or display associated with the B Time Base.

B SECONDS/DIV — Time per major graticule division. Selects calibrated sweep rates from 0.2 μs/Div to 0.5 s/Div; 20 steps in a 1-2-5 sequence. Knob skirt is illuminated to provide direct readout of the sweep rate.

B TRIGGERING SOURCE

LEFT: Selects the left vertical plug-in as the trigger-signal source for the B Time Base.

RIGHT: Selects the right vertical plug-in as the trigger-signal source for the B Time Base.

LINE: Selects line-frequency voltage as the trigger-signal source for the B Time Base.

B TRIGGERING COUPLING/SLOPE

AC COUPL: Button pushed in selects AC (capacitive) coupling of triggering signals; button out selects DC coupling.

+ SLOPE: Button pushed in selects the positive slope of the triggering signal; button out selects the negative slope.

# GENERAL INFORMATION

## Preparation

The 5B12N is calibrated and ready for use as it is received. It can be installed in any compartment of the 5100-Series Oscilloscope, but it is intended for principal use in the horizontal (right) compartment. If the instrument is used in one of the vertical compartments (for example, to provide a vertical sweep), there is no retrace blanking; however, if used in the right vertical (center) compartment, internal triggering is provided.

To install, align the upper and lower rails of the 5B12N with the oscilloscope plug-in tracks and fully insert it (the plug-in panel must be flush with the oscilloscope panel). To remove, pull the release latch to disengage the 5B12N from the oscilloscope. Even though the horizontal gain of the oscilloscope is standardized to eliminate adjustment when inserting plug-in units, the sweep calibration of the 5B12N should be checked to verify measurement accuracy.

## Triggering Source (A and B)

**LEFT, RIGHT, or COMPOSITE.** The LEFT and RIGHT buttons of the A and B TRIGGERING SOURCE switches permit selection of the triggering signal from either vertical plug-in unit. In addition, the A TRIGGERING SOURCE permits selection of the triggering signal from the signal being displayed (both LEFT and RIGHT buttons pushed in). This internal triggering normally provides the most convenient operation, because the sweep can be started at a selected point on a displayed signal.

*NOTE*

*If the composite trigger mode is selected when this unit is installed in a 5403, the unit will trigger off the left vertical plug-in only.*

When the 5B12N is operated in a dual-sweep mode in which both vertical plug-ins are active (Display On), the signal from the left vertical unit is displayed with the A Time Base and the signal from the right vertical unit is displayed with the B Time Base. For stable internal triggering with non-related signals, select LEFT as the A Triggering Source and RIGHT as the B Triggering Source.

**LINE.** When the LINE button of either switch is pressed, a sample of the power-line frequency is connected to the corresponding Trigger Preamplifier circuit. Line triggering is useful when the input signal is time-related to the line frequency. It is also useful for providing a stable display of a line-frequency component in a complex waveform.

**EXT (A Sweep Only).** An external signal connected to the A EXT INPUT connector can be used to trigger the A Sweep when the EXT button is pressed. The external signal must be time-related to the displayed signal to produce a stable display. An external triggering signal can be used to provide a triggered display when the internal signal is too low in amplitude for correct triggering, or contains components on which it is not desired to trigger. It is also useful when signal tracing in amplifiers, phase-shift networks, wave-shaping networks, etc. The signal from a single point in the circuit can be connected to the A EXT INPUT connector through a signal probe or cable. The A Sweep is then triggered by the same signal at all times, allowing examination of amplitude, time relationship, or wave-shape changes of signals at various points in the circuit without resetting the triggering controls.

## Triggering Coupling (A and B)

Two methods of coupling the triggering signal to the A and B Trigger Preamplifier circuits can be selected. When the Coupling button is pushed in, AC coupling is selected, and when the button is out, DC coupling is selected.

The AC coupling capacitor blocks the DC component of the triggering signal. Low-frequency components below about 50 hertz are attenuated. In general, AC coupling can be used for most applications. However, if the triggering signal contains unwanted components, or if the sweep is to be triggered at a low repetition rate or a DC level, DC coupling should be used.

## Trigger Slope (A and B)

The SLOPE switches determine whether a sweep is initiated on the positive-going or negative-going portion of the triggering signal. When the button is pushed in (+ position), the display starts with the positive-going portion of the waveform; when the button is out (— position), the display starts with the negative-going portion of the waveform. 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 required to provide a display which starts on the desired slope of the input signal.

*NOTE*

*When this plug-in is used in a Tektronix 5403 oscilloscope the leading edge of the display will not be observed when using sweep rates faster than 1 μs.*

## Triggering Level (A and B)

The TRIGGERING LEVEL controls determine the voltage level of the triggering signals at which the sweep circuits are triggered. The + and — regions on the panel adjacent to the knobs correspond to the more positive and more negative points on the triggering signal, or to the relative screen position when using an internal trigger source and DC coupling.

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

## Sweep Mode—Independent A or B Sweep Operation

**General.** The A and B buttons of the MODE switch are self-cancelling, and permit independent operation of either the A or B sweep. Both buttons can be pushed in together, permitting dual-sweep operation; this will be discussed later under Sweep Mode—Dual-Sweep and Delayed-Sweep Operation.

**Normal Triggered Mode.** The Normal Triggered Mode (AUTO TRIG button out) provides a repetitive triggered display on either time base only when the corresponding LEVEL control is correctly set and an adequate triggering signal applied. Otherwise, the sweep-generating circuits remain off and there is no display.

**Auto Mode and Bright Baseline.** Operation in this mode (AUTO TRIG button pushed in) provides a repetitive, triggered display when the triggering signal is occurring at a rate of 15 hertz or more and the LEVEL control is correctly set. When the trigger-repetition rate is less than about 15 hertz, or in the absence of an adequate triggering signal, the selected sweep generator free runs at the sweep rate selected by the SECONDS/DIV switch to produce a reference trace. When an adequate triggering signal is again applied, the free-running condition ends and the sweep generator is triggered to produce a stable display.

**Single Sweep Mode (A Time Base).** When the A SINGL SWP button is pushed in, operation of the A sweep generator circuits is similar to the normal modes, except that only one sweep can be produced until the sweep is manually reset. This mode can be used to photograph a non-repetitive signal. Also, when the signal to be displayed is not repetitive, or varies in amplitude, shape, or time, use of the Single Sweep Mode eliminates the possibility of an unstable presentation.

To use the Single Sweep Mode, first make sure the A Time Base triggering circuits will respond to the event to be displayed. Set the A SINGL SWP button for repetitive sweep (button out) and obtain the best possible triggered display in the normal manner (for random signals, set the A LEVEL control so that the triggering circuit will respond to a signal which is about the same amplitude as the random signal). Then push in the A SINGL SWP button and press the RESET button to arm the sweep. This condition is indicated by the READY lamp, which lights when the A sweep generator is ready to accept a trigger. The next trigger pulse initiates the sweep, and a single trace will be presented on the screen. The READY light goes out immediately upon receipt of the sweep-initiating trigger. After the single sweep is terminated, the sweep generator is "locked out" until again reset. To prepare the circuit for another single-sweep display, press the RESET button again. In all modes, any sweep in process when the RESET button is pressed is terminated, allowing the system to be quickly reset.

**Selecting Sweep Rate.** The A SECONDS/DIV switch (dark gray knob) provides 21 calibrated A Time Base sweep rates ranging from one microsecond per division to five seconds per division, and the B SECONDS/DIV switch (light gray knob) provides 20 calibrated B Time Base sweep rates ranging from 0.2 microsecond per division to 0.5 second per division. The Variable control (red knob) is associated with the A Time Base. It provides continuously variable sweep rates between the settings of the A SECONDS/DIV switch, and extends the sweep rate range to about 12.5 seconds per division. The knob skirts of the A and B switches are back-lighted to provide a direct readout of both sweep rates.

**Sweep Magnification (A Time Base).** The sweep magnifier expands the A sweep ten times. The center one division of the unmagnified display is the portion visible on the screen when magnified. Equivalent length of the magnified sweep is about 100 divisions; any 10-division portion may be viewed by adjusting the A POSITION control to bring the desired portion into the viewing area.

To use sweep magnification, first move the portion of the display which is to be expanded to the center of the graticule. Then press the A SWP MAG button. The knob-skirt readout changes by a factor of ten to provide a direct readout of the magnified sweep rate.

**Sweep Calibration Check.** The vertical and horizontal deflection systems of the 5100-series oscilloscopes are gain-standardized to permit a plug-in to be moved from one oscilloscope to another (or from one compartment to another within the oscilloscope) without the need to recheck the calibration each time. However, the sweep timing of both time bases can be checked and, if necessary, adjusted.

## Sweep Mode—Dual-Sweep and Delayed Sweep Operation

**General.** In addition to the independent A or B sweep operation discussed previously, the MODE switch permits simultaneous operation of both the A and B sweeps where both are viewed simultaneously (dual sweep), or where only one is viewed, but is dependent upon the other (A sweep intensified by the B sweep, B sweep delayed, etc.).

**Dual Sweep.** Dual-sweep operation is attained by pushing in both the A and B buttons of the mode switch. In this mode, the A sweep and the B sweep displays are viewed

simultaneously on a time-shared basis established by the electronic switching circuit in the oscilloscope mainframe. Of the four available time slots provided by the mainframe, two are allocated to the A Time Base and two are allocated to the B Time Base in an A-A-B-B, etc., sequence. This allows a signal to be displayed at two different sweep rates, or two signals to be displayed at independent sweep rates. The vertical switching sequence is discussed in the 5100-series Oscilloscope System manual. Either the Alternate or Chop display modes can be used. In general, the Alternate mode is most useful at the faster sweep rates, and the Chop mode is most useful at the slower sweep rates or when the two sweep rates are significantly different. A built-in trace separation feature automatically deflects the A sweep downward about two divisions when the dual-sweep mode is selected, which separates a single-trace baseline. The front-panel INTEN BAL control is provided to balance the intensity levels of the A and B sweeps for best viewing or photography.

In addition to independent dual-sweep operation, this mode can also be used for simultaneous display of dependent sweeps (delaying and delayed sweeps).

**Delayed Sweep.** When the A INTEN-B DLY'D button of the MODE switch is pushed in, a delayed sweep mode is established. This button is used in conjunction with the A and B buttons as described previously to display the desired time base. In the delayed sweep mode, the B Time Base provides the delayed sweep, which starts after a time interval provided by the A Time Base (delaying sweep). The sweep rate of the delayed sweep (B) is determined by the B SECONDS/DIV switch setting. The delay time is the interval between the start of the A sweep and the start of the B sweep. It is determined by the A SECONDS/DIV switch setting and the DELAY TIME MULT dial setting.

*NOTE*

*The delay time is not absolute, due to the inherent delay of up to 500 nanoseconds in the start of the delayed sweep.*

A displayed A sweep appears with a portion of the trace intensified when the A INTEN-B DLY'D button is pushed in. The intensified zone (produced by the B sweep) is the portion of the A sweep that will be displayed by the B sweep. Refer to Fig. 1-1. The length of the intensified portion is about 10 times the setting of the B SECONDS/DIV switch; thus, it can be lengthened or shortened by changing the B sweep rate. In most cases, the B sweep should be operated at a faster rate than the A sweep in the delayed sweep mode to avoid illogical displays.

The delayed sweep mode permits the differential delay time between two displayed events to be accurately measured. Points for differential time measurement are selectable over the 10-division length of the A sweep, by turning the DELAY TIME MULT dial to position the intensified zone to the points. The points are displayed by the B sweep, allowing the reference to be precisely established. The DELAY TIME MULT dial provides readings that correspond to the distance from the start of the A sweep to the selected point (for example, a dial reading of 2.95 indicates 2.95 graticule divisions). The difference between any two dial readings, multiplied by the A SECONDS/DIV switch setting, is the differential delay time.

When the B TRIG AFTER DLY button is pushed in, the delayed sweep mode is modified to permit a triggered B sweep which is delayed for a selected time (see Fig. 2-1B). Instead of starting exactly at the point selected by the DELAY TIME MULT dial, the B sweep starts later when a trigger pulse is received. The B TRIGGER SOURCE, LEVEL, and SLOPE controls operate as described in this section under Independent Sweep Operation. The B Triggerable After Delay mode is similar to the A Single Sweep mode, in that the B sweep is "armed" after the delay time, but must be triggered independently.

## Amplifier Mode

In some applications, it is desirable to display one signal versus another (X-Y) rather than against time (Y-T). The Amplifier Mode provides a means for applying an external signal to the horizontal amplifier for this type of display.

When the A SECONDS/DIV or VOLTS/DIV switch is rotated counterclockwise into the VOLTS/DIV portion of the switch, the internal and line triggering inputs are grounded and the A sweep generator circuit is disabled (including the CRT blanking gate). The external signal is routed through the amplifier portions of the circuitry and made available to the oscilloscope deflection system.

The external signals may be capacitive coupled (AC) or direct coupled (DC) by using the A Coupling pushbutton; however, the remainder of the A TRIGGERING switches and controls located within the dark green area on the front panel are disabled. Two calibrated deflection factors are provided; 50 millivolts per division and 0.5 volt per division. The Variable control provides a continuously variable 1X to 10X attenuation of the input signal. All of the B Time Base triggering and sweep circuits remain fully operable, permitting simultaneous X-Y and Y-T displays (Chop mode must be used for this type of display).

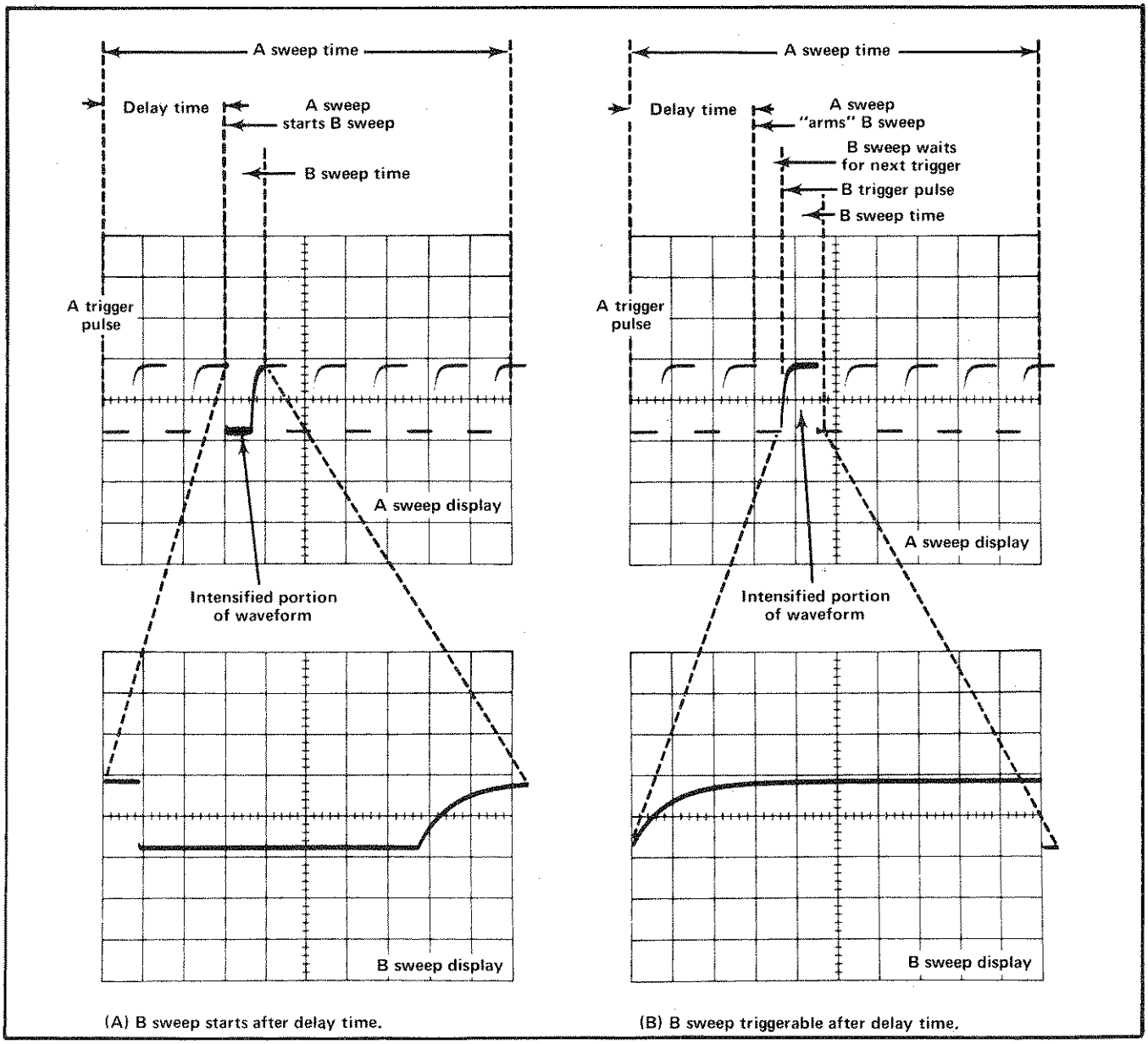



Fig. 1-1. Comparison of the delayed-sweep modes. In each display, the B sweep is delayed a selected amount of time by the A sweep.

## APPLICATIONS

### General

The following information describes procedures and techniques for making basic delayed-sweep measurements and for other specific 5B12N applications. These applications are not described in detail, since each application must be adapted to the requirements of the individual measurement. Refer to the 5100-Series Oscilloscope System manual for basic oscilloscope applications and reference sources.

*NOTE*

*The following procedures make use of the dual-sweep feature of the 5B12N to allow simultaneous viewing of the delaying and delayed sweeps. For clarity, the illustrations show each display separately.*

### Delayed Sweep Time Measurement

The delayed sweep mode can be used to make accurate time measurements. The following measurement determines

the time difference between two pulses displayed on the same trace. This application may also be used to measure time difference from two sources or to measure time duration of a single pulse.

1. Apply a signal to the input connectors of both vertical plug-in units. Push in both the A and B buttons of the MODE switch to establish a dual-sweep display. Set the Volts/Div switches to produce displays about two divisions in amplitude.

2. If possible, set the A SECONDS/DIV switch to a calibrated sweep rate which displays several divisions between the pulses. Adjust the A Triggering controls for a stable display. Use the Chop display mode at slower sweep rates to eliminate the blinking effect caused by sweep alternation.

3. Push in the A INTEN-B DLY'D button and set the B SECONDS/DIV switch to a setting 1/100th of the A SECONDS/DIV sweep rate. This produces an intensified portion about 0.1 division in length.

4. Turn the DELAY TIME MULT dial to move the intensified zone on the A sweep to the rising portion of the first pulse. Continue to adjust the DELAY TIME MULT dial to move the rising portion of the B sweep display (delayed sweep) to some vertical reference line. Note the setting of the DELAY TIME MULT dial.

5. Turn the DELAY TIME MULT dial clockwise until the second pulse on the delayed sweep is positioned to this same point. Again note the dial setting.

6. Subtract the first dial setting from the second and multiply the results by the A SECONDS/DIV switch setting. This is the time interval between the pulses.

Example: Assume the first dial setting is 1.31 and the second dial setting is 8.81 with the A SECONDS/DIV switch set to 0.2 ms (see Fig. 1-2). From the formula given in step 6:

Time Difference (delayed sweep) =

(8.81 − 1.31) X 0.2 ms = 1.5 milliseconds

The time difference is 1.5 milliseconds.

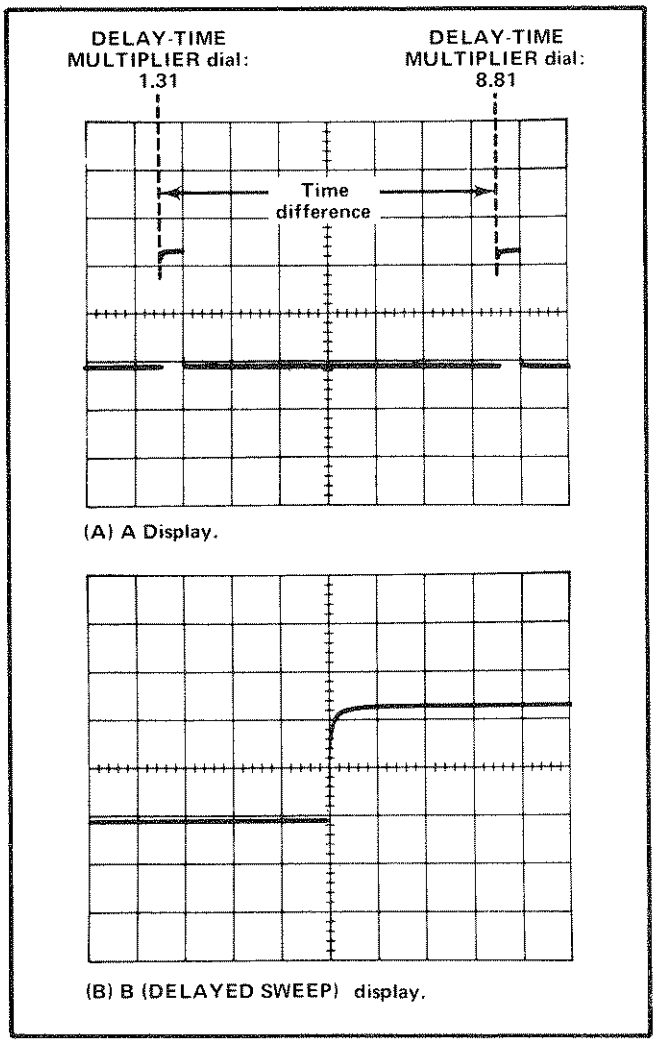



Fig. 1-2. Measuring time difference using delayed sweep.

## Sweep Magnification Using the Delayed Sweep

The delayed sweep feature of the 5B12N can be used to provide higher apparent sweep magnification than is provided by the A SWP MAG switch. The portion of the display or an event to be magnified is selected on the A sweep as an intensified segment, and then presented by the B sweep at a rate selected by the B SECONDS/DIV switch. The following method uses the B DLY'D mode to allow the delayed portion to be positioned with the DELAY TIME MULT dial. If there is too much jitter in the delayed display, see the Triggered Delay Sweep information following step 5.

1. Apply a signal to the input connectors of both vertical plug-in units. Push in both the A and B buttons of the MODE switch to establish a dual-sweep display. Set the Volts/Div switch to produce displays about three divisions in amplitude.

2. Set the A SECONDS/DIV switch to a calibrated sweep rate which displays the complete waveform. Adjust

the A Triggering controls for a stable display. Use the Chop display mode at slower sweep rates to eliminate the blinking effect caused by sweep alternation.

3. Push in the A INTEN-B DLY'D button and position the start of the intensified zone with the DELAY TIME MULT dial to the part of the display to be magnified.

4. Set the B SECONDS/DIV switch to a setting which intensifies the full portion of the A sweep to be magnified. The start of the intensified zone remains as positioned above.

5. The magnified portion of the A sweep is displayed on the B sweep. Accurate time measurements can be made from the display in the conventional manner. Sweep rate of the magnified portion is determined by the setting of the B SECONDS/DIV switch.

Example: The apparent magnification of the display shown in Fig. 1-3 with an A SECONDS/DIV switch setting of .1 ms and a B SECONDS/DIV switch setting of 1 $\mu$s is:

$$\text{Apparent Magnification} = \frac{\text{A SECONDS/DIV setting}}{\text{B SECONDS/DIV setting}} = \frac{1 \times 10^{-4}}{1 \times 10^{-6}} = 100$$

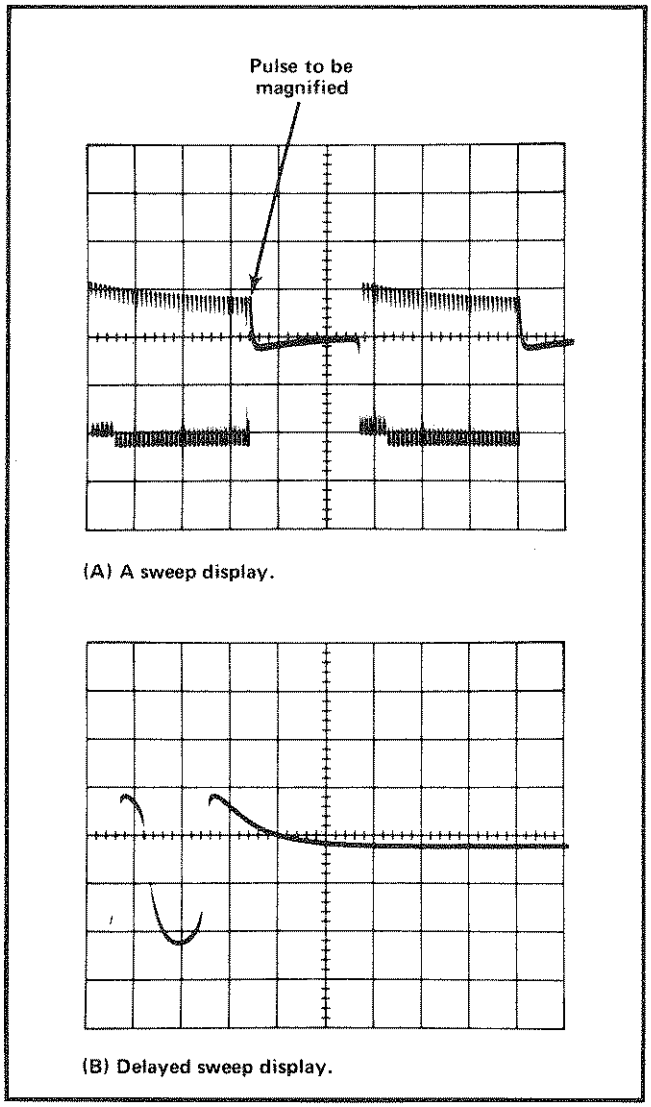
The apparent magnification is 100 times.

**Sweep Magnification Using Triggered Delayed Sweep.** The delayed sweep magnification method just described may produce too much jitter at high apparent magnification ranges. The B TRIG AFTER DLY mode provides a more stable display, because the delayed display is triggered at the same point each time.

1. Establish the display as given in steps 1 through 4 above.

2. Push in the B TRIG AFTER DLY button and adjust the B TRIGGERING LEVEL control so the intensified zone on the trace is stable.

3. Measurement and magnification are as described above.




(A) A sweep display.

(B) Delayed sweep display.

Fig. 1-3. Using the delayed sweep for sweep magnification.

## Displaying Complex Signals Using Delayed Sweep

Complex signals often consist of a number of individual events of differing amplitudes. Since the trigger circuits are sensitive 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 B sweep by a selected amount following the event which triggers the A sweep generator circuit. Then the part of the waveform containing the information of interest can be displayed.

1. Establish a display as given in Sweep Magnification Using the Delayed Sweep steps 1 through 5.

Example: Fig. 1-3 shows a complex waveform displayed on the A sweep. The indicated pulse cannot be viewed in any greater detail because the sweep is triggered by the larger amplitude pulses at the start of the display, and a faster sweep rate moves this area of the waveform off the viewing area. The second waveform shows the area of interest magnified 100 times using the delayed sweep. The DELAY TIME MULT dial has been adjusted so the delayed sweep starts just before the area of interest.

### Pulse Jitter Measurements

In some applications, it is necessary to measure the amount of jitter on the leading edge of a pulse, or jitter between pulses.

1. Apply a signal to the input connectors of both vertical plug-in units. Push in both the A and B buttons of the MODE switch to establish a dual-sweep display. Set the Volts/Div switches to produce displays about four divisions in amplitude.

2. Set the A SECONDS/DIV switch to a calibrated sweep rate which displays the complete waveform. Adjust the A Triggering controls for a stable display.

3. Push in the A INTEN-B DLY'D button and position the start of the intensified portion with the DELAY TIME MULT dial to the pulse to be measured. Set the B SECONDS/DIV switch to a setting that intensifies the full portion of the pulse of interest.

4. Pulse jitter is shown by horizontal movement of the pulse (take into account inherent jitter of Delayed Sweep; see Electrical Characteristics). Measure the amount of horizontal movement, then multiply this distance by the B SECONDS/DIV switch setting to obtain pulse jitter in time.

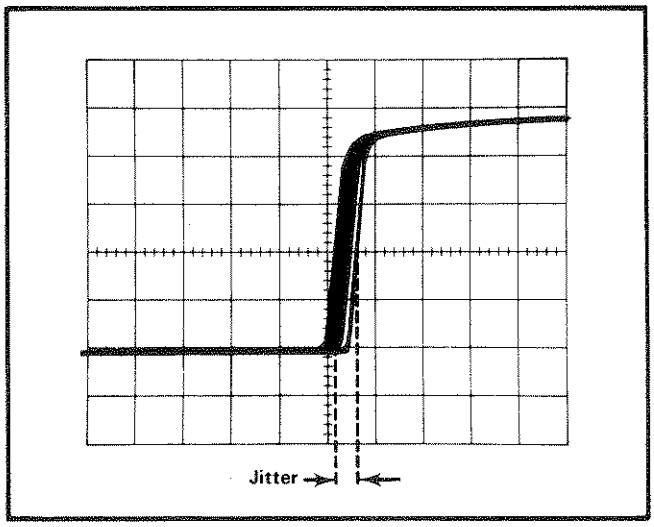



Fig. 1-4. Measuring pulse jitter.

Example: The horizontal movement shown in Fig. 1-4 is 0.5 division, and the B SECONDS/DIV switch setting is 0.2 μs. From the formula given in step 4:

Pulse Jitter = 0.5 (divisions) X 0.2 μs (B SECONDS/DIV setting) = 0.10 μs.

The pulse jitter is 0.1 microsecond.

## ELECTRICAL CHARACTERISTICS

### Performance Conditions

The following characteristics apply when the 5B12N is operating within the environment described in the 5100-Series Oscilloscope System manual. In addition, the 5B12N must have been calibrated at an ambient temperature between +20°C and +30°C.

In this manual the word Volts/Div or division refers to major graticule division.

### A Sweep Rate

CALIBRATED RANGE: 5 s/div to 1 μs/div in a 21 step, 1-2-5 sequence. X10 magnifier extends sweep rate to 100 ns/div.

DISPLAYED ACCURACY: Within 3% from 1 μs/div to 1 s/div. Within 4% from 2 s/div to 5 s/div. (Add 1% to magnified sweep.)

UNCALIBRATED (VARIABLE) RANGE: Continuously variable between steps and to 12.5 s/div.

### B Sweep Rate

CALIBRATED RANGE: 0.5 s/div to 0.2 μs/div in a 20 step, 1-2-5 sequence.

DISPLAYED ACCURACY: Within 3% from 1 μs/div to 0.1 s/div. Within 4% at 0.2 μs/div, 0.5 μs/div, 0.2 s/div and 0.5 s/div.

### Position Range

Any portion of the sweep can be positioned on screen.

### Sweep Delay

DELAY TIME MULTIPLIER RANGE: 0.2 to 10.2 times the A SECONDS/DIV setting (continuously variable from 1 μs to 50 s).

DELAY TIME ACCURACY: Within 1% from 1 μs/div to 0.5 s/div. Within 2% from 1 s/div to 5 s/div. Inherent delay to start of delayed sweep is 500 ns or less.

INCREMENTAL DELAY TIME MULTIPLIER LINEARITY: Within 0.2% of full scale.

DIFFERENTIAL TIME MEASUREMENT ACCURACY: Within 1% and 2 minor dial divisions from 1 μs to 0.5 s delay time. Within 2% and 2 minor dial divisions from 1 s to 5 s delay times.

DELAY TIME JITTER: 1 part or less in 20,000 of ten times the A SECONDS/DIV setting.

### Internal Triggering

DC (DIRECT) COUPLED: At least 0.4 div, DC to 1 MHz. At least 0.6 div @ 2 MHz.

AC (CAPACITIVE) COUPLED: At least 0.4 div, 50 Hz to 1 MHz. At least 0.6 div @ 2 MHz.

### External Triggering (A Sweep Only)

DC (DIRECT) COUPLED: At least 200 mV, DC to 2 MHz.

AC (CAPACITIVE) COUPLED: At least 200 mV, 50 Hz to 2 MHz.

INPUT R AND C: 1 MΩ within 2% paralleled by approximately 70 pF.

MAXIMUM OPERATIONAL INPUT VOLTAGE: + and −5 V.

MAXIMUM SAFE INPUT VOLTAGE: 350 V (DC + peak AC).

### Internal Level Range

DC (DIRECT) COUPLED: + and −8 div from graticule center.

AC (CAPACITIVE) COUPLED: + and −8 div from signal mean.

### External Level Range (A Sweep Only)

DC (DIRECT) COUPLED: + and −5 V.

AC (CAPACITIVE) COUPLED: + and −5 V from signal mean.

### Amplifier Mode

DEFLECTION FACTOR: 0.5 V/div and 50 mV/div within 3%.

UNCALIBRATED (VARIABLE) RANGE: At least 10:1.

BANDWIDTH (8 DIV REFERENCE): DC to at least 1 MHz. 50 Hz to at least 1 MHz, AC (capacitive) coupled.

INPUT R AND C: 1 MΩ within 2% paralleled by approximately 70 pF.

USEFUL INPUT VOLTAGE: + and −5 V.

MAXIMUM SAFE INPUT VOLTAGE: 350 V (DC + peak AC).