

## FEATURES OF 5103N OSCILLOSCOPE

- LOW COST, MODULAR
- UNEQUALED VERSATILITY USING INTERCHANGEABLE PLUG-INS PLUS INTERCHANGEABLE DISPLAY MODULES PLUS BENCH-TO-RACK CONVERTIBILITY
- LARGE 6½-INCH CRT (8 x 10 DIV)
- CHOICE of STORAGE DISPLAYS
- MAINFRAME ACCEPTS UP to THREE PLUG-INS
- BANDWIDTH to 2 MHz
- 10 μV/DIV HIGH GAIN DIFFERENTIAL
- ONE to EIGHT TRACE CAPABILITY
- SIMULTANEOUS DISPLAY of TWO INDEPENDENT TIME BASES DELAYED SWEEP
- LIGHTED KNOB SKIRTS for SCALE FACTOR READOUT
- Y-T or X-Y OPERATION
- SIMPLIFIED CONSTRUCTION, EASY to MAINTAIN, RELIABLE
- COLOR CODED FRONT PANELS for EASY OPERATION
- LIGHT WEIGHT, EASY to CARRY
- SOLID STATE STABILITY

When Tektronix, Inc. introduced the first plug-in oscilloscope, customer acceptance quickly established this concept as one of the outstanding contributions to instrumentation. The ability to interchange display units in an oscilloscope, and the ability to convert between cabinet and rackmount configurations is introduced in the 5100 Series.

This oscilloscope system provides present and future measurement capabilities at a sound price/performance ratio, and the user will realize continuing benefits from this new concept as it is applied to tomorrow's oscilloscopes.

Low frequency oscilloscope users are no longer confronted with choosing a non-plug-in oscilloscope designed to meet specific measurement criteria, or a more costly wide bandwidth plug-in oscilloscope. To date, plug-in oscilloscopes have been designed for mid or high frequency use and as such were often too expensive for lower frequency requirements. Therefore, the low frequency oscilloscope buyer has been unable to purchase an instrument which suited his particular measurement needs at a price/performance ratio comparable to that which exists for users of higher frequency oscilloscopes. To solve this problem, Tektronix, Inc. designed the 5103N Oscilloscope System.

Users of low frequency oscilloscopes now have the versatility of plug-ins, PLUS the new versatility of interchangeable display units, PLUS the versatility of converting to and from cabinet or rackmount—PLUS prices consistent with his measurement needs. These features allow choice of an instrument for immediate individual requirements and unequalled ability to change the configuration when applications change.

The 5103N Oscilloscope System consists of five interchangeable display modules, eleven amplifier plug-ins, three time base plug-ins and a power supply/amplifier module with three plug-in compartments.

The 5103N mainframe module contains the low voltage power supplies, some vertical and horizontal circuitry and the electronic switching and logic circuitry for dual trace or dual beam operation. The display module may be attached in a cabinet model or rackmount configuration.

## DISPLAY MODULES

All five modules have 3.5-kV accelerating potential and intern graticules. P31 phosphor is standard for the nonstorage unit and a phosphor similar to P1 is standard for the storage unit. These modules include the power switch, a voltage-current-tin calibrator, a beam finder which positions the beam on screen regardless of vertical and horizontal control settings, the controls related to the CRT display, and the Z-axis input. Each powered from the 5103N mainframe.

The Storage Display Modules have an adjustable control to vary the stored brightness level to retain information up to 10 hours at specified resolution and without damaging the CRT. Even at high output light levels the storage CRT is highly resistant to burns, and requires no more care than a conventional CRT. The stored brightness control used in conjunction with the other storage controls also allows "integration" to increase the effective writing rate.

Dual Beam Display Modules have two writing guns and two pairs of vertical deflection plates. One pair of horizontal deflection plates drive both beams, which cover the full 8 x 10 division screen.

MAINFRAME AND INTERCHANGEABLE DISPLAY UNITS

| PRODUCT                       | PAGE | FEATURES   |                  |                          |
|-------------------------------|------|--|------------------|--------------------------|
|                               |      | BEAMS  | BISTABLE STORAGE | DISPLAY SIZE             |
| 5103N MAINFRAME               | 117  | Power Supply/Amplifier Unit compatible with each of five interchangeable display units |                  |                          |
| INTERCHANGEABLE DISPLAY UNITS |      |  |                  |                          |
| D10                           | 118  | Single   |                  | 8 x 10 div<br>(½ in/div) |
| D11                           | 118  | Single   | Yes              | 8 x 10 div<br>(½ in/div) |
| D12                           | 118  | Dual   |                  | 8 x 10 div<br>(½ in/div) |
| D13                           | 118  | Dual   | Yes              | 8 x 10 div<br>(½ in/div) |
| D15                           | 118  | Single   | Yes              | 8 x 10 div<br>(½ in/div) |

## PLUG-INS

Scale factor readout is provided by back-lighted skirt knobs which automatically indicate the correct reading when using the X10 magnifier and the recommended 1X and 10X probes. The lights turn off when a plug-in or a channel is switched off.

Scale factor readout prevents many measurement errors and provides an easy, quick means of identifying deflection factors and sweep rates and indicating which channels are in use—even in low ambient room light.

## AMPLIFIER PLUG-INS

| PRODUCT | PAGE | TRACES                       | MINIMUM DEFLECTION FACTOR | BANDWIDTH —3 dB | CMRR      |  |
|---------|------|------------------------------|---------------------------|-----------------|-----------|--|
| 5A13N   | 120  | Single                       | 1 mV                      | 2 MHz           | 10,000:1  |  |
| 5A14N   | 121  | Four                         | 1 mV                      | 1 MHz           |           |  |
| 5A15N   | 121  | Single                       | 1 mV                      | 2 MHz           |           |  |
| 5A18N   | 121  | Dual                         | 1 mV                      | 2 MHz           |           |  |
| 5A19N   | 124  | Single                       | 1 mV                      | 2 MHz           | 1,000:1   |  |
| 5A20N   | 122  | Single                       | 50 $\mu$ V                | 1 MHz           | 100,000:1 |  |
| 5A21N   | 122  | Single (Voltage and Current) | 50 $\mu$ V<br>0.5 mA      | 1 MHz           | 100,000:1 |  |
| 5A22N   | 123  | Single                       | 10 $\mu$ V                | 1 MHz           | 100,000:1 |  |
| 5A23N   | 124  | Single                       | 10 mV/div                 | 1.5 MHz         |           |  |
| 5A24N   | 124  | Single                       | 50 mV/div                 | 2 MHz           |           |  |
| 5CT1N   | 127  | Semiconductor Curve Tracer   |                           |                 |           |  |

## TIME BASE PLUG-INS

| PRODUCT | PAGE | DUAL and DELAYED SWEEP | SWEEP RATE                                 | MAG | SINGLE SWEEP | VOLTS/DIV EXT MODE |
|---------|------|------------------------|--|-----|--------------|--------------------|
| 5B10N   | 125  |                        | 1 $\mu$ s to 5 s                           | X10 | Yes          | 50 mV and 500 mV   |
| 5B12N   | 126  | Yes                    | A 1 $\mu$ s to 5 s<br>B 2 $\mu$ s to 0.5 s | X10 | Yes          | 50 mV and 500 mV   |
| 5B13N   | 127  |                        | 1 $\mu$ s to 100 ms                        |     |              | 50 mV              |

## 5100 Series Plug-in Dimensions and Weights

| Dimensions | in   | cm   | Weights (Approx)  | lb   | kg  |
|------------|------|------|-------------------|------|-----|
| Height     | 5.0  | 12.5 | Net               | 2.8  | 1.2 |
| Width      | 2.6  | 6.7  | Domestic Shipping | 10.0 | 4.5 |
| Length     | 12.0 | 30.5 | Export Packed     | 15.0 | 6.9 |

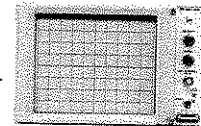
## Oscilloscope Dimensions and Weights

| Dimensions        | CABINET |      | RACKMOUNT |      |
|-------------------|---------|------|-----------|------|
|                   | in      | cm   | in        | cm   |
| Height            | 11.5    | 29.5 | 5.3       | 13.5 |
| Width             | 8.5     | 21.5 | 19.0      | 48.0 |
| Length            | 20.0    | 50.9 | 19.0      | 48.3 |
| Weights (approx)  | lb      | kg   | lb        | kg   |
| Net               | 23.0    | 10.5 | 23.0      | 10.5 |
| Domestic Shipping | 32.0    | 14.5 | 42.0      | 19.0 |
| Export Packed     | 44.0    | 20.0 | 59.0      | 24.5 |

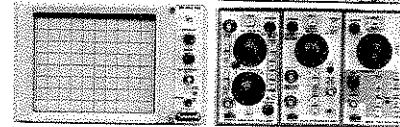
## SELECT EITHER CONFIGURATION

Add The CRT DISPLAY UNIT

HERE 



OR  
HERE 



## 5103N MAINFRAME CHARACTERISTICS VERTICAL SYSTEM

**Channels**—Two plug-in compartments (left and center) compatible with all 5100-Series Plug-Ins.

**Deflection Factor**—Determined by plug-in unit.

**Bandwidth**—2 MHz maximum.

**Chopped Mode**—The 5103N will chop between two amplifiers, at an approx 25-kHz to 100-kHz rate, depending on plug-ins used and operating modes. The chop mode is selected from the time base unit.

**Alternate Mode**—In this mode each amplifier plug-in is swept twice before switching to the next. A single-trace amplifier is swept twice and each channel of a dual-trace amplifier is swept once before the 5103N switches to the second amplifier. When two vertical amplifiers are used with the 5B12N Dual Time Base, the left amplifier can be slaved to the A sweep, and the right amplifier slaved to the B sweep in the dual-sweep mode.

## HORIZONTAL SYSTEM

**Channel**—One right-hand plug-in compartment compatible with all 5100-Series Plug-Ins. Dual sweep is available with the 5B12N Time Base.

**Fastest Calibrated Sweep Rate**—0.1  $\mu$ s/div (X10 mag) with 5B10N or 5B12N.

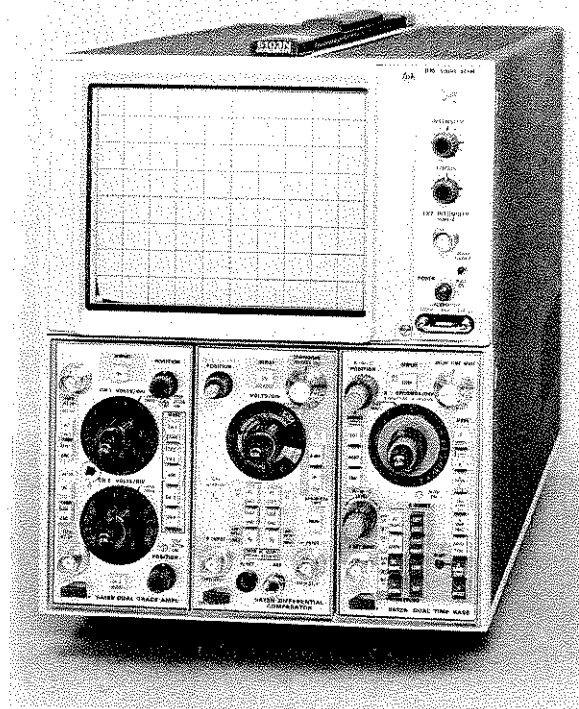
**X-Y Mode**—PHASE SHIFT is within 1° from DC to 100 kHz, checked with two amplifiers of the same type.

## OTHER CHARACTERISTICS

**Ambient Temperature**—Performance characteristics are valid from 0°C to +50°C.

**Power Requirements**—100, 110, 120, 200, 220, and 240 V ( $\pm$ 10% on each range), 50 to 60 Hz and 440 Hz; internally selectable with quick-change jumpers.

- 8 x 10 DIV CRT  
1/2 IN/DIV
- BRIGHT DISPLAYS
- CABINET or 5/4-INCH  
RACKMOUNT OSCILLOSCOPE
- DC COUPLED Z-AXIS INPUT



5103N/D10



D10

**D10****SINGLE BEAM DISPLAY UNIT**

The D10 provides a single beam conventional display for the 5103N Mainframe. The electrostatic-deflection cathode-ray tube has an 8 x 10 division (1/2 in/div) display area with internal graticule. A bright display is provided by a 3.5 kV accelerating potential. P31 phosphor is standard; P7 or P11 optional without extra charge.

**D11 and D15****SINGLE BEAM STORAGE DISPLAY UNITS**

The D11 and D15 provide storage displays for the 5103N Mainframe. Each unit features a single-beam, 6 1/2-inch 8 x 10-div (1/2 in/div) CRT with bistable, split-screen storage and an internal graticule. Accelerating potential is 3.5 kV and the phosphor is similar to P1. The D11 has a brighter stored display. The D15 has the higher stored writing speed (center 6 x 8 div).

D11 writing speed is at least 20 div/ms (Normal mode only). D15 writing speed is at least 200 div/ms in the normal mode and 800 div/ms (>1000 cm/ms) in the enhanced mode. Storage viewing time is at least one hour at normal intensity. A variable brightness control allows the storage time to be extended to at least 10 hours at reduced intensity, after which time the intensity may be increased to its original level. Variable brightness also permits optimum photographic results, and integration of multiple traces. Erase time is  $\approx 250$  ms.

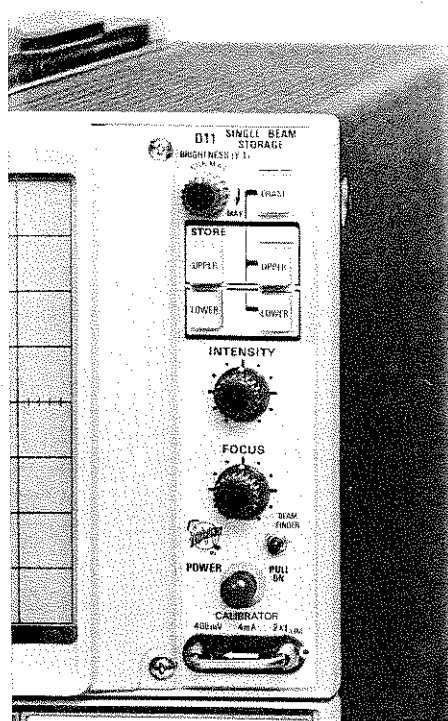
**D12****DUAL BEAM DISPLAY UNIT**

The D12 provides a dual beam display for the 5103N Mainframe. Dual beam oscilloscopes are essential to the many applications where two transient events must be compared simultaneously. Application areas include stimulation and reaction events in areas such as medicine, biology, chemistry, engineering mechanics and many other electronic and scientific measurement areas. Both beams of the D12 are driven by one set of horizontal deflection plates. When using a dual time base plug-in in the dual sweep mode, both beams will be deflected by both sweeps and with two single trace plug-ins four traces will be displayed. Other characteristics are the same as the D10 Single Beam Display Unit.

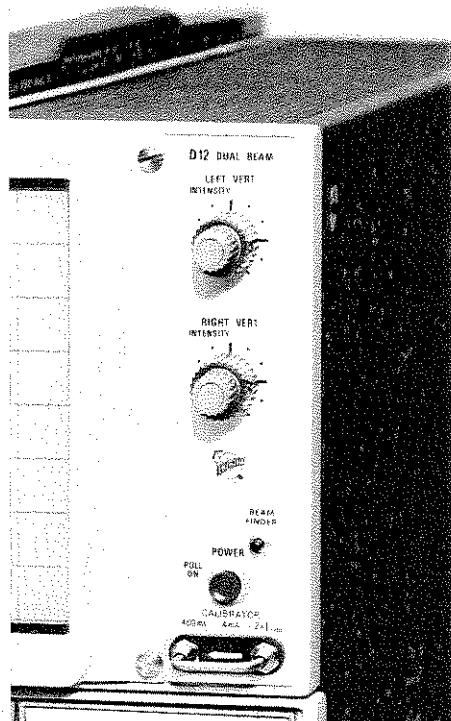
**D13****DUAL BEAM STORAGE DISPLAY UNIT**

The D13 provides a dual beam, bistable, split-screen storage display for the 5103N Mainframe. The storage display characteristics and operation are the same as the D11 Storage Display Unit. Other characteristics are the same as the D12. No measurement problems are continuously developing which can only be solved with a dual beam storage oscilloscope. Experimenters and researchers in areas such as electronics, mechanics and bio-medicine recognize the expediency and thoroughness of dual beam storage for retaining two related transients.

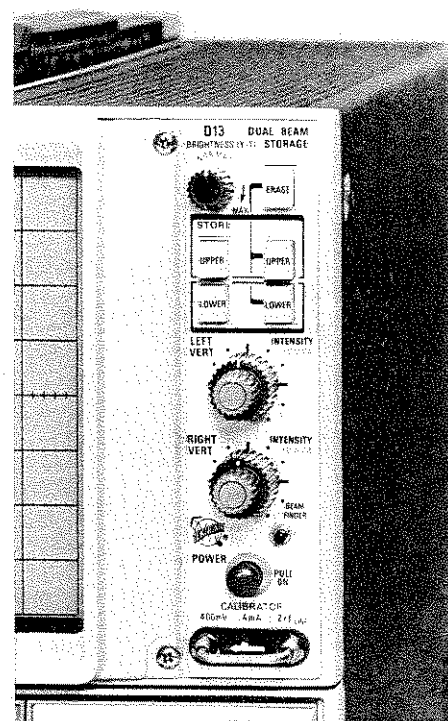
Writing speed is at least 20 div/ms. (Option 3, 200 div/ms, center 6 x 8 div). Storage time is at least one hour at normal intensity increasing to 10 hours at reduced intensity. Erase time is  $\approx 250$  ms.



D11 and D15



D12



D13

### COMMON CHARACTERISTICS

**External Intensity Input**—5 V will turn the beam on to full brightness from an off level. Frequency range is DC to 1 MHz. Input R and C is  $\approx 10 \text{ k}\Omega$  paralleled by  $\approx 40 \text{ pF}$ . Maximum input is  $\pm 50 \text{ V}$  (DC + peak AC).

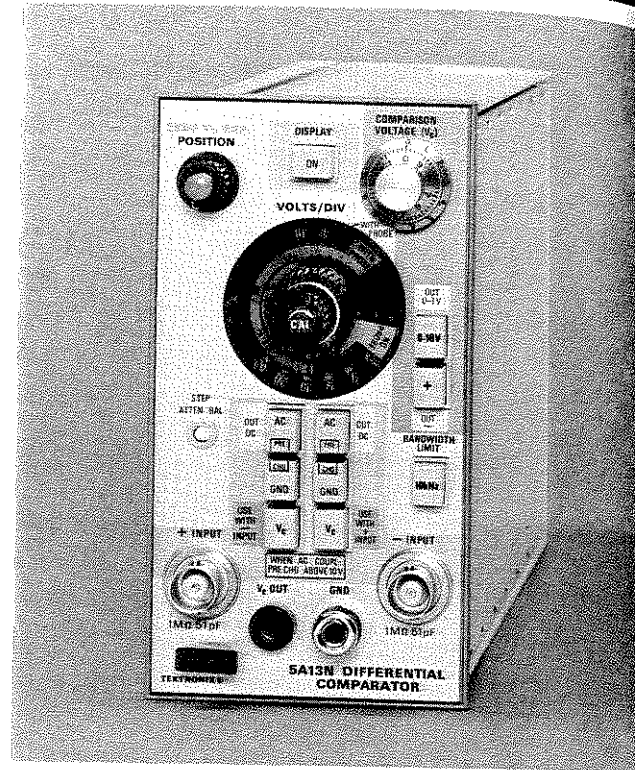
**Calibrator**—Voltage output is 400 mV within 1%. Current output (loop) is 4 mA within 1%. Frequency is 2X line.

**Beam Finder**—When pressed, the beam is positioned on screen, regardless of vertical and horizontal position control settings.

**Power Requirements**—100, 110, 120, 200, 220, and 240 V ( $\pm 10\%$  on each range), 50 to 60 Hz and 400 Hz. Internally selectable with quick-change jumpers.

**5100-SERIES OSCILLOSCOPES**  
**5A13N Differential Comparator Amplifier**

- DC-to-2 MHz BANDWIDTH
- 1 mV/DIV to 5 V/DIV
- 10,000:1 CMRR
- 10,000 DIV EFFECTIVE SCREEN HEIGHT



The 5A13N is a differential comparator plug-in amplifier for the 5103N Oscilloscope System. It incorporates a number of performance features which make it particularly versatile, especially in multi-trace combination with other 5100-Series vertical plug-ins. The following operational areas describe the functions of the 5A13N.

**Conventional Mode**—as a conventional amplifier the 5A13N has constant bandwidth over the 1 mV/div to 5 V/div deflection factor range. The bandwidth is selectable at 2 MHz or 10 kHz for best displayed noise conditions during low-frequency applications. The plus or minus inputs allow normal or inverted displays.

**Differential Mode**—as a differential amplifier the 5A13N maintains its conventional features and provides a balanced input for applications requiring rejection of a common-mode signal. The CMRR is 10,000:1 from DC to 20 kHz, decreasing to 100:1 at 2 MHz. The unit rejects up to 15 V of common-mode signal at a deflection factor setting of 1 mV/div, increasing to 350 V rejection capability above 100 mV/div.

**Comparator Mode**—as a comparator amplifier the 5A13N utilizes its differential capabilities, but provides an accurate positive or negative internal offsetting voltage. A signal of up to  $\pm 10$  V may be applied to an input (plus or minus) at a deflection factor setting of 1 mV/div and viewed in 10,000 divisions by offsetting the signal with the opposing comparison voltage. A  $\pm 1$  V comparison voltage is also available for application requiring maximum resolution. The offset voltage may be externally monitored through a front panel output.

**CHARACTERISTICS**

**Bandwidth**—DC to 2 MHz. Bandwidth Limit Mode, DC to 10 kHz. AC Coupled, 2 Hz or less at the lower -3 dB point.

**Deflection Factor**—1 mV/div to 5 V/div in a 1-2-5 sequence. Accuracy is within 3%. Uncalibrated, continuously variable between steps and to at least 12.5 V/div.

**Input R and C**—1 M $\Omega$ , approx 51 pF.

**Signal Range**

|  |                   |                  |
|--|-------------------|------------------|
| DEFLECTION FACTOR SETTINGS                           | 1 mV to 50 mV/div | 0.1 V to 5 V/div |
| COMMON-MODE SIGNAL RANGE                             | $\pm 15$ V        | $\pm 350$ V      |
| MAX DC COUPLED INPUT (DC + PEAK AC at 1 kHz or less) | $\pm 350$ V       | $\pm 350$ V      |
| MAX AC COUPLED INPUT (DC VOLTAGE)                    | $\pm 350$ V       |                  |

**Max Input Gate Current**—0.1 nA or less (equivalent to 100 or less, depending on external loading) at 25°C.

**Overdrive Recovery**—1  $\mu$ s to recover to within 3.0 mV  $\pm$  0.1 ms to recover to within 1.5 mV after the removal of an overdrive signal between +15 V and -15 V, regardless of overdrive signal duration.

**Internal Comparison Voltage**—Ranges, 0 V to  $\pm 10$  V, and to  $\pm 1$  V. Accuracy, within 0.2% of dial setting plus 5% from  $\pm 1$  V to  $\pm 10$  V; within 0.2% of dial setting plus 1% from  $\pm 25$  mV to  $\pm 1$  V on the 0 V to  $\pm 1$  V range. From 0 V  $\pm 25$  mV use the on-screen display for greater resolution. output R, approx 15 k $\Omega$ .

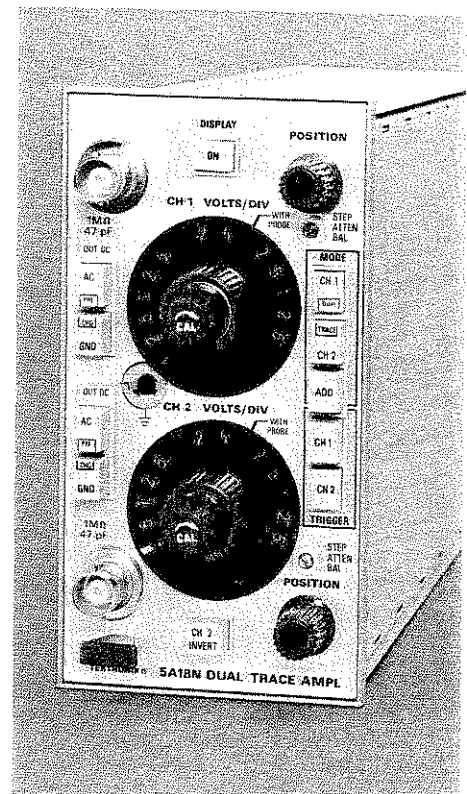
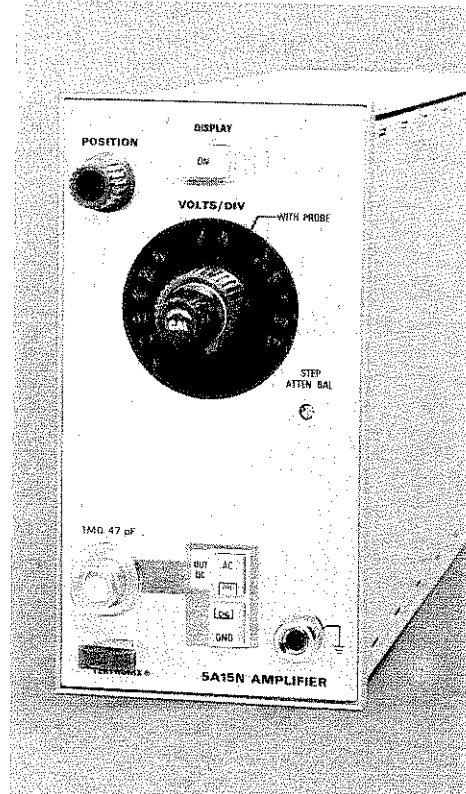
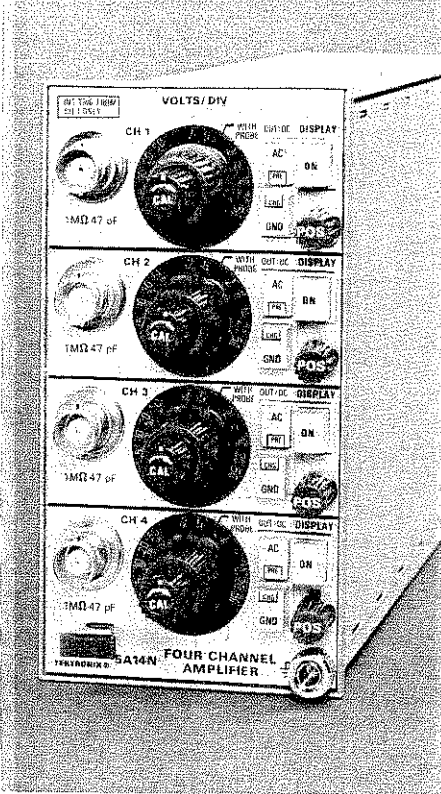
**Common-Mode Rejection Ratio**—At least 10,000:1, DC to 10 kHz at 1 mV/div to 50 mV/div DC coupled, with up to 20-volt peak-to-peak sine wave, decreasing to 100:1 at 1 MHz. At least 400:1, DC to 10 kHz at 0.1 V/div to 5 V/div DC coupled, with up to 100-volt peak-to-peak sine wave, decreasing to 40:1 at 1 MHz. For frequencies above 5 kHz AC coupled, CMRR the same as stated for DC coupled. Below 5 kHz AC coupled CMRR decreases to 400:1 at 10 Hz. CMRR with two P60 probes is at least 400:1 at any deflection factor.

**Order 5A13N DIFFERENTIAL COMPARATOR AMPLIFIER** ..... \$5

**Recommended Probes**—See page 128.

U.S. Sales Prices FOB Beaverton, Oregon  
 Please refer to Reference page





● 1mV/DIV to 5V/DIV

The 5A15N (single channel), 5A18N (two identical channels) and 5A14N (four identical channels) are amplifiers with solid-state circuits. Each features simplified front panel controls and is used in the 5103N Mainframe. These plug-ins may be used in combination for displaying up to eight traces. For instance, two 5A14N amplifiers provide eight traces; one each 5A14N and 5A15N amplifiers provide five traces. Each amplifier may be used in the 5103N horizontal plug-in compartment for X-Y operation.

5A18N operating modes include channel one or two only, channels one and two added, and channel one alternate or chopper with channel two. Internal trigger source is selectable from channel one and channel two.

5A14N operating modes are each channel separately, and alternate or chop between any combination of channels. Internal trigger is available from channel one only.

**CHARACTERISTICS**

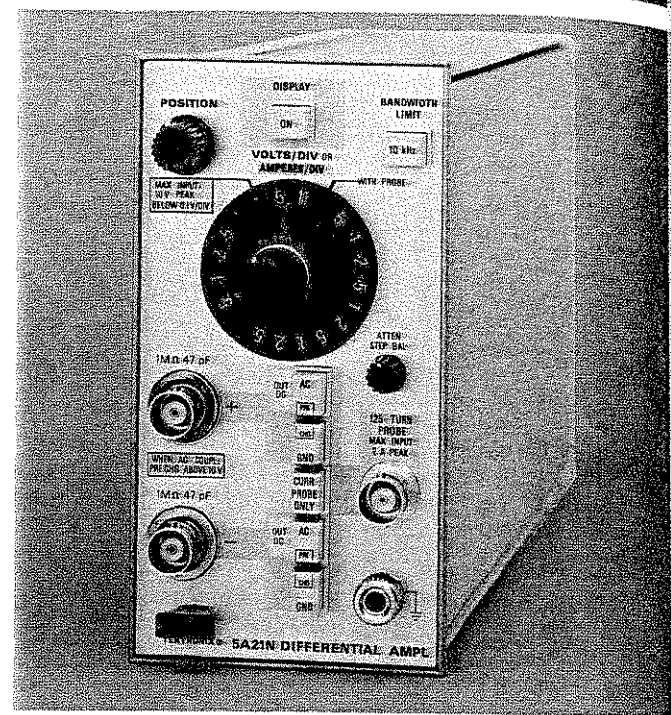
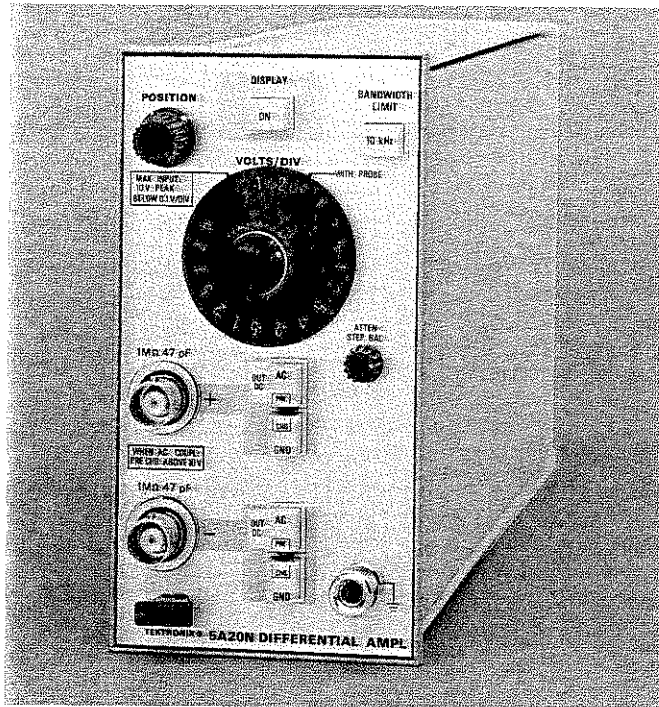
**Bandwidth**—DC coupled, DC to at least 2 MHz (5A14N, 1 MHz) at all deflection factors. AC coupled, 2 Hz or less to at least 2 MHz (5A14N, 1 MHz) at all deflection factors.

**Deflection Factor**—1 mV/div to 5 V/div in 12 calibrated steps (1-2-5 sequence). Accuracy is within 2%. Uncalibrated, continuously variable between calibrated steps and to 12.5 V/div.

**Input R and C**—1 MΩ within 1%, approx 47 pF.

**Maximum Input**—DC coupled, 350 V (DC + peak AC). AC coupled, 350 VDC.

**Chopping Rate (5A18N and 5A14N)**—25 kHz to 100 kHz depending upon plug-in combinations and number of traces displayed.



- DC-to-1 MHz BANDWIDTH
- 10-kHz BANDWIDTH LIMITER
- 50  $\mu\text{V}/\text{DIV}$  to 5  $\text{V}/\text{DIV}$
- 100,000:1 CMRR
- VOLTAGE and CURRENT PROBE INPUTS (5A21N)

The 5A20N and 5A21N are 50  $\mu\text{V}/\text{div}$ , DC coupled differential amplifiers for the 5103N Oscilloscope System. The units are identical except that the 5A21N has a current probe input. Each plug-in is compatible with each compartment of the 5103N Mainframe. By inserting a vertical plug-in unit into the horizontal compartment, the user assembles an X-Y oscilloscope. Thus, the oscilloscope can be adapted to solve individual application problems.

#### 5A20N AND 5A21N VOLTAGE CHARACTERISTICS

**Bandwidth**—DC coupled, DC to at least 1 MHz. AC coupled, 2 Hz or less to at least 1 MHz. Bandwidth may be limited to 10 kHz.

**Deflection Factor**—50  $\mu\text{V}/\text{div}$  to 5  $\text{V}/\text{div}$  in 16 calibrated steps (1-2-5 sequence). Accuracy is within 2%. Uncalibrated, continuously variable between calibrated steps and to 12.5  $\text{V}/\text{div}$ .

**Input R and C**—Voltage mode, 1  $\text{M}\Omega$  within 0.15%, approx 47 pF.

#### Maximum Input Voltage

|  | DC COUPLED           | AC COUPLED                                       |
|--|----------------------|--|
| 50 $\mu\text{V}/\text{div}$ to 50 $\text{mV}/\text{div}$ | 10 V (DC + peak AC)  | 350 VDC (Coupling cap pre-charged), 10 V peak AC |
| 100 $\text{mV}/\text{div}$ to 5 $\text{V}/\text{div}$    | 350 V (DC + peak AC) | 350 V (DC + peak AC)                             |

**Input Gate Current**—100 pA or less (equivalent to 100  $\mu\text{V}$  or less, depending on external loading) at 25°C.

**Displayed Noise**—30  $\mu\text{V}$  or less, tangentially measured.

**Common-Mode Rejection Ratio**—AC coupled, 50  $\mu\text{V}/\text{div}$  to 0.5  $\text{mV}/\text{div}$ , at least 20,000:1 at 5 kHz and above decreasing to 400:1 at 10 Hz. DC coupled, at least 100,000:1, DC to 30 kHz at 50  $\mu\text{V}/\text{div}$  and 100  $\mu\text{V}/\text{div}$  with up to 20 V P-P sinewave, decreasing by less than 20 dB/decade on sensitivity ranges up to 50  $\text{mV}/\text{div}$ . From 100  $\text{mV}/\text{div}$  to 5  $\text{V}/\text{div}$ , CMRR is at least 400:1 with up to 100 V P-P sinewave. CMRR with two P6080 probes is at least 400:1 at any deflection factor.

#### 5A21N CURRENT PROBE INPUT CHARACTERISTICS (WITH P6021 CURRENT PROBE)

**Bandwidth**—15 Hz or less, to at least 1 MHz. Bandwidth may be limited to 10 kHz.

**Deflection Factor**—0.5  $\text{mA}/\text{div}$  to 0.5  $\text{A}/\text{div}$  in 10 calibrated steps (1-2-5 sequence). Accurate within 3%. Uncalibrated, continuously variable between steps and to 1.25  $\text{A}/\text{div}$ .

**Maximum Input Current**—4 A P-P (at probe loop) with 125-turn P6021 Current Probe.

**Displayed Noise**—300  $\mu\text{A}$  or less, tangentially measured. Performance characteristics are valid for the 5A20N and 5A21N from 0°C to +50°C.

- DC-to-1-MHz BANDWIDTH
- 10  $\mu\text{V}/\text{DIV}$  to 5 V/DIV
- 100,000:1 CMRR
- SELECTABLE UPPER and LOWER  $-3$  dB POINTS
- DC OFFSET

There are many factors which contribute to the usability and performance of this high-gain, wideband differential amplifier. Displayed noise (grounded inputs) is held to 20  $\mu\text{V}$  or less at 10  $\mu\text{V}/\text{div}$ , tangentially measured at full bandwidth. Since noise is related to bandwidth, the displayed noise can be greatly reduced with the HF  $-3$  dB point selector. Low amplitude signals often ride a small DC component, perhaps a few millivolts, which would place a DC-coupled display offscreen at 10  $\mu\text{V}/\text{div}$ . Or, DC drift may be present in the signal to be measured. Low frequency drift is minimized by using AC coupled inputs for frequencies above 2 Hz or by using DC coupled inputs and low frequency limits selectable by a front panel switch. The same techniques are used to cancel a DC component from the signal being measured. Adding a DC voltage opposite in polarity to the polarity of the disturbing DC component is a third method. This is done by using the plug-in's variable DC offset. Full bandwidth is retained in this mode of operation. These and other factors make the 5A22N well suited for measurements in difficult, low-amplitude, low-frequency areas.

### CHARACTERISTICS

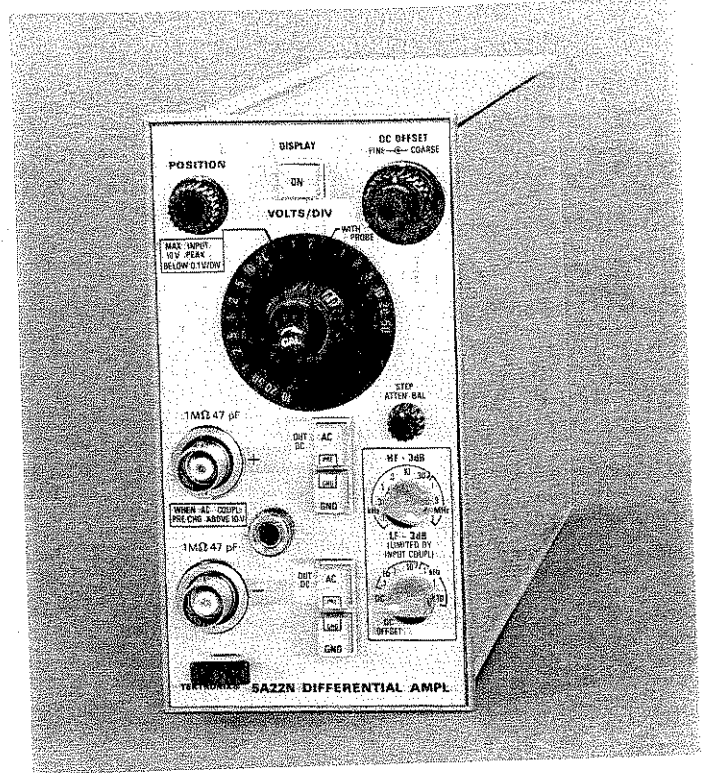
**Bandwidth**—HF  $-3$  dB point: selectable in 9 steps (1-3 sequence) from 100 Hz to 1 MHz. 100 Hz to 0.3 MHz, accurate within 20% of selected frequency and at 1 MHz, bandwidth is down 3-dB or less. LF  $-3$  dB point: selectable in 6 steps (1-10 sequence) from 0.1 Hz to 10 kHz, accurate within 20% of selected frequency. AC coupled, 2 Hz or less.

**Deflection Factor**—10  $\mu\text{V}/\text{div}$  to 5 V/div in a 1-2-5 sequence. Accuracy is within 3%. Uncalibrated, continuously variable between steps and to at least 12.5 V/div.

**Input R and C**—1 M $\Omega$  within 0.15%, approx 47 pF.

**Drift With Temperature**—100  $\mu\text{V}/^\circ\text{C}$  or less.

**Max Input Gate Current**—200 pA or less.



Signal and Offset Range

| DEFLECTION FACTOR SETTINGS                           | 10 $\mu\text{V}$ to 50 mV/div                           | 0.1 V to 5 V/div |
|--|---|------------------|
| COMMON-MODE SIGNAL RANGE                             | $\pm 10$ V  | $\pm 350$ V      |
| MAX DC COUPLED INPUT (DC + PEAK AC AT 1 kHz OR LESS) | $\pm 12$ V  | $\pm 350$ V      |
| MAX AC COUPLED INPUT (DC VOLTAGE)                    | $\pm 350$ V<br>DC rejection, at least $4 \times 10^5:1$ |                  |
| DC OFFSET RANGE                                      | +0.5 V to -0.5 V  | +50 V to -50 V   |

**Displayed Noise**—20  $\mu\text{V}$  at maximum bandwidth, source resistance 25  $\Omega$  or less, measured tangentially.

**Overdrive Recovery**—10  $\mu\text{s}$  or less to recover within 0.5% of zero level after removal of a test signal applied for 1 s. Signal amplitude not to exceed common-mode signal range.

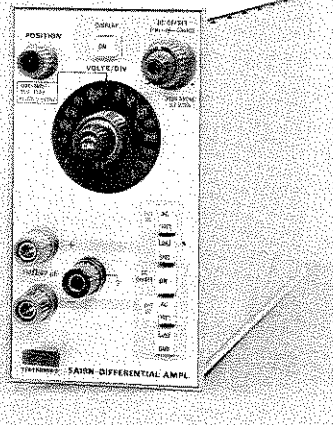
**Common-Mode Rejection Ratio**—AC coupled, 10  $\mu\text{V}/\text{div}$  to 0.5 mV/div, at least 20,000:1 at 5 kHz and above, decreasing to 400:1 at 10 Hz. DC coupled, at least 100,000:1, DC to 30 kHz from 10  $\mu\text{V}/\text{div}$  to 100  $\mu\text{V}/\text{div}$  with up to 20 V P-P sinewave, decreasing by less than 20 dB/decade on sensitivity ranges up to 50 mV/div. From 100 mV/div to 5 V/div, CMRR is at least 400:1 with up to 100 V P-P sinewave. CMRR with two P606 probes is at least 400:1 at any deflection factor.





**NEW 5A19N  
DIFFERENTIAL  
AMPLIFIER**

- DC-to-2 MHz BANDWIDTH
- 1 mV/DIV to 20 V/DIV
- DC OFFSET



The 5A19N is a low cost differential amplifier featuring variable DC offset and simplicity of controls. It is ideal for monitor and systems applications and operates in the left or middle plug-in compartment of the 5103N mainframe for Y-T displays, or in the right compartment for X-Y displays.

**Bandwidth**—DC coupled, DC to at least 2 MHz at all deflection factors. AC coupled, 2 Hz or less to at least 2 MHz at all deflection factors.

**Deflection Factors**—1 mV/div to 20 V/div in a 1-2-5 sequence. Accuracy is within 2%. Uncalibrated, continuously variable between calibrated steps and to 50 V/div.

**Input R and C**—1 MΩ within 0.3%, approx 47 pF.

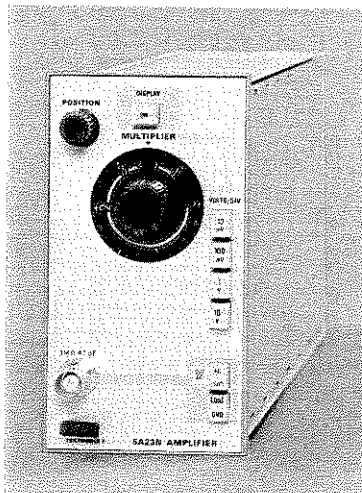
**Signal and Offset Range**

|  |                        |                        |
|--|------------------------|------------------------|
| DEFLECTION FACTOR SETTINGS                           | 1 mV/div to 200 mV/div | 500 mV/div to 20 V/div |
| COMMON-MODE SIGNAL RANGE                             | ±16 V                  | ±350 V                 |
| MAX DC COUPLED INPUT (DC + PEAK AC AT 1 kHz OR LESS) | ±350 V                 |                        |
| MAX AC COUPLED INPUT (AC VOLTAGE)                    | ±350 V                 |                        |
| DC OFFSET RANGE                                      | +15 V to -15 V         | +350 V to -350 V       |

**Common-Mode Rejection Ratio**—DC coupled, 1 mV/div to 200 mV/div, at least 1000:1 from DC to 10 kHz; decreasing to 100:1 at 500 mV/div to 20 V/div.

**5A23N  
AMPLIFIER**

- 10 mV/DIV to 10 V/DIV CALIBRATED DEFLECTION FACTORS



The 5A23N is a general-purpose amplifier for the 5103N Oscilloscope System. Featuring low cost and simplicity of controls, it is ideal for monitor and systems applications. It operates in the left or middle plug-in compartment of the 5103N mainframe for Y-T displays, or in the right compartment for X-Y displays.

**Bandwidth**—DC coupled, DC to at least 1.5 MHz at all deflection factors. AC coupled, 2 Hz or less to at least 1.5 MHz at all deflection factors.

**Deflection Factor**—10 mV/div to 10 V/div within 3% in 4 calibrated decade steps. A lighted multiplier control provides continuous variation between steps, and extends the deflection factor range to 100 V/div. Accuracy is within 5% at X2 and X5 multiplication.

**Input R and C**—1 MΩ within 1%, approx 47 pF.

**Maximum Input**—350 volts (DC + peak AC).

**5A24N  
AMPLIFIER**

- 50 mV/DIV to 1 V/DIV DEFLECTION FACTORS
- EASY TO CUSTOMIZE



The 5A24N is a low-cost utility plug-in providing direct access to either the vertical or horizontal deflection system of the 5103N mainframe. It contains mode switching, CRT beam positioning, trigger pick-off for basic measurements, and a built-in 3% x 2% -inch soldering pad matrix for use by the customer who wishes to build his own input circuits for special applications. Customer-built circuits are powered through the circuit board which provides access to all mainframe power supplies.

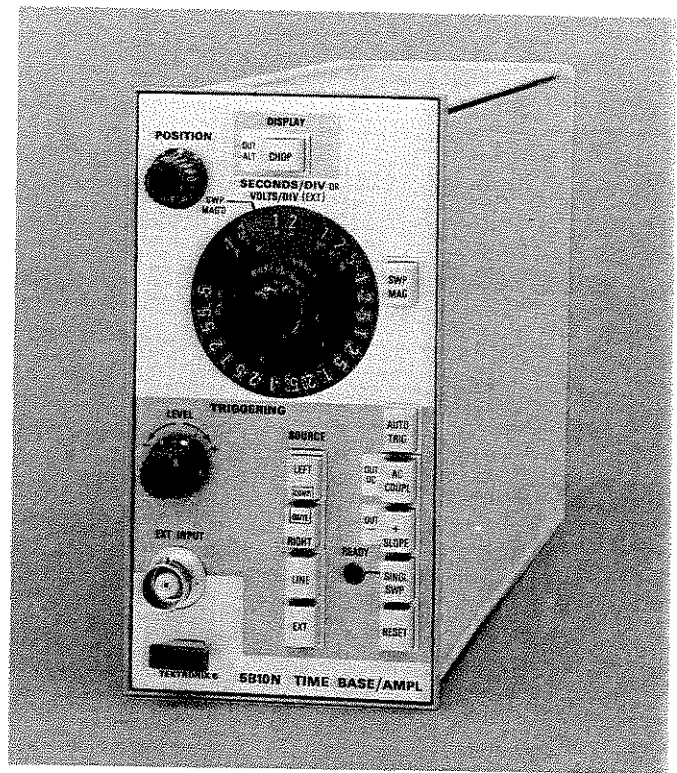
**Bandwidth**—DC coupled, DC to at least 2 MHz at 50 mV/div, decreasing to DC to 200 kHz at mid-attenuator range. AC coupled, 25 Hz to at least 2 MHz at 50 mV/div, decreasing to 25 Hz to 200 kHz at mid-attenuator range. Uncompensated input.

**Deflection Factor**—50 mV/div, accurate within 3%. Continuously variable, uncalibrated from 50 mV/div to at least 1 V/div.

**Input R and C**—Approx 100 kΩ, approx 30 pF.

**Maximum Input**—50 volts (DC + peak AC).

- 100 ns/DIV to 5 s/DIV CALIBRATED TIME BASE
- SINGLE SWEEP
- DIRECT READOUT X10 MAG
- PROVIDES ALTERNATE and CHOPPED DISPLAYS
- 50 mV/DIV and 500 mV/DIV CALIBRATED EXTERNAL INPUT



The 5B10N is a time base/amplifier plug-in unit for generating a sweep in the 5103N Oscilloscope System. An external input allows use of the 5B10N as a voltage amplifier with calibrated deflection factors of 50 mV/div and 500 mV/div.

Triggering the 5B10N is straightforward even with the many triggering modes which are push button selected. Source positions include left or right plug-in, composite (from the mainframe vertical amplifier), line and external.

The 5B10N is normally used in the right hand plug-in compartment but is compatible with the vertical amplifier compartments as well.

### CHARACTERISTICS

**Sweep Rates**—1  $\mu$ s/div to 5 s/div in 21 calibrated steps (1-2-5 sequence). X10 magnifier extends displayed sweep time/div to 100 ns. Uncalibrated, continuously variable between steps and to 12.5 s/div.

**Sweep Accuracy**—Unmagnified, within 3% from 1  $\mu$ s/div to 1 s/div, and within 4% at 2 s/div and 5 s/div. Magnified displays accurate within 1% in addition to specified time base sweep accuracy.

### TRIGGERING

| COUPLING |          | TO 1 MHz                          | AT 2 MHz |
|----------|----------|-----------------------------------|----------|
| DC       | Internal | 0.4 div                           | 0.6 div  |
|          | External | 200 mV                            | 200 mV   |
| AC       |          | Requirements increase below 50 Hz |          |

**Auto Trig**—Same as above except signal rate requirements are 15 Hz and above.

**Single Sweep**—Same as for AC and DC coupled.

**External Trigger Input**—Maximum input voltage is 350 V (DC + peak AC). Input R and C is 1 M $\Omega$  within 2% paralleled by  $\approx$ 70 pF. Trigger level voltage range is +5 V to -5 V.

### EXTERNAL HORIZONTAL MODE

**Deflection Factor**—50 mV/div and 500 mV/div, accurate within 3%. 10X variable extends range to at least 5 V/div.

**Bandwidth**—DC coupled, DC to at least 1 MHz. AC coupled, 50 Hz or less to at least 1 MHz.

**Input R and C**—1 M $\Omega$  within 2%, approx 70 pF.

**Maximum Input Voltage**—350 V (DC + peak AC).

U.S. Sales Prices FOB Beaverton, Oregon  
Please refer to Reference page

- 100 ns/DIV to 5 s/DIV CALIBRATED TIME BASE
- DUAL and DELAYED SWEEP
- DIRECT READOUT X10 MAG

The 5B12N is a time base for generating single, dual or delayed sweeps in the 5103N Oscilloscope System. The 5B12N is normally used in the right hand plug-in compartment but is compatible with the vertical amplifier compartments as well.

The display modes are A sweep, B sweep, A intensified—B delayed and dual sweep. Each mode is selectable by push-button switches. Triggering sources for A and B sweep include left and right plug-in, line and display composite. In the display composite mode the sweep is triggered from the composite signal being displayed. Auto and external trigger and single sweep are provided for the A sweep. The B sweep is triggerable after the delay time. The 5B12N triggers to frequencies well beyond the oscilloscope bandwidth.

When operated in the dual sweep mode in a dual-beam oscilloscope together with two amplifier plug-ins, first the A sweep and then the B sweep displays the signals from both amplifiers, therefore four traces will be displayed. Both sweeps are displayed simultaneously in Chop Mode.

When operated in the dual sweep mode in a single-beam oscilloscope together with two amplifier plug-ins, the A sweep is slaved to the left plug-in and the B sweep is slaved to the right plug-in.

The display mode push button selects Chop or Alternate time-share switching between vertical plug-ins and amplifier channels. Chop rate is 25 kHz to 100 kHz depending on plug-in combinations and number of traces displayed.

### CHARACTERISTICS

**A Sweep Rates**—1  $\mu$ s/div to 5 s/div in 21 calibrated steps (1-2-5 sequence). X10 magnifier extends displayed sweep time/div to 100 ns. Uncalibrated, continuously variable between steps and to 12.5 s/div.

**A Sweep Accuracy**—Unmagnified, within 3% from 1  $\mu$ s/div to 1 s/div and within 4% at 2 s/div and 5 s/div. Magnified, displays accurate within 1% in addition to specified time base sweep accuracy.

**B Sweep Rates**—0.2  $\mu$ s/div to 0.5 s/div in 20 calibrated steps.

**B Sweep Accuracy**—Within 3% from 1  $\mu$ s/div to 0.1 s/div. Within 4% at 0.2  $\mu$ s/div, 0.5  $\mu$ s/div, 0.2 s/div and 0.5 s/div.

### TRIGGERING

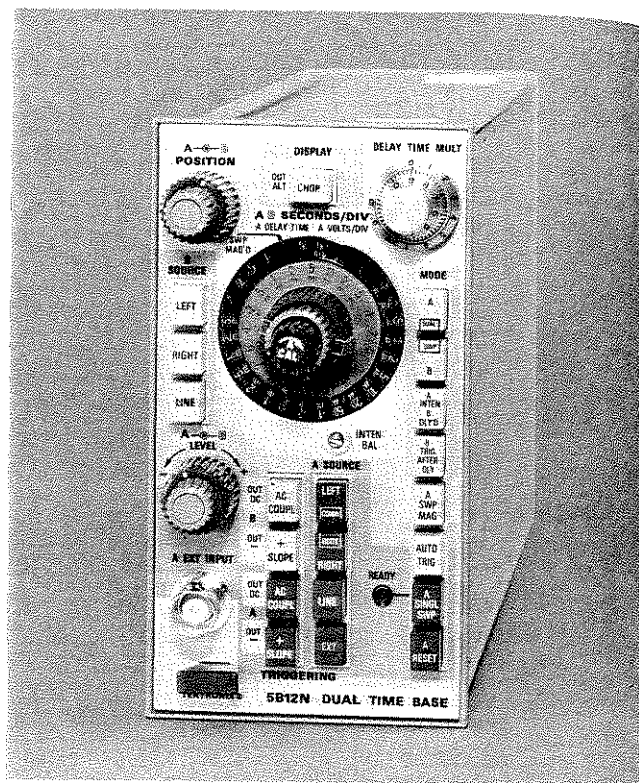
The following applies to the A and B trigger except as noted.

| COUPLING |           | TO 1 MHz                          | AT 2 MHz |
|----------|-----------|-----------------------------------|----------|
| DC       | Internal  | 0.4 div                           | 0.6 div  |
|          | External* | 200 mV                            | 200 mV   |
| AC       |           | Requirements increase below 50 Hz |          |

\*A trigger only.

B sweep operates in triggered or free-run mode after delay time.

**Auto Trig**—Same as above on signal rates of 15 Hz and above.



The following characteristics apply to the A trigger only.

**Single Sweep**—Same as for AC and DC coupled.

**External Trigger Input**—Maximum input voltage is 350 V (1 + peak AC). Input R and C is 1 M $\Omega$  within 2% paralleled  $\approx$ 70 pF. Trigger level voltage range is +5 V to -5 V.

### DELAYING SWEEP CHARACTERISTICS

**Delay Time Accuracy**—1  $\mu$ s/div to 0.5 s/div, within 1%. 1 s/c to 5 s/div, within 2%.

**Delay Time Multiplier Range**—0.2 to 10.2 times the Time/D setting.

**Delay Time Multiplier Incremental Linearity**—Within 0.2%.

**Differential Time Measurement Accuracy**—Within 1% and minor dial divisions for 1  $\mu$ s to 0.5 s delay times. Within 2 and 2 minor dial divisions for 1 s to 5 s delay times.

**Jitter**—1 part or less in 20,000 of 10X the A Time/Div setting.

### EXTERNAL HORIZONTAL MODE

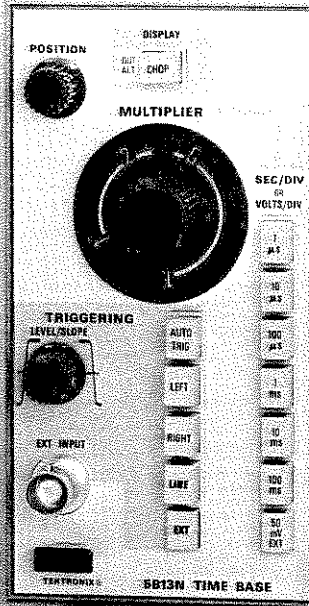
**Deflection Factor**—50 mV/div and 500 mV/div accurate within 3%. 10X variable extends range to at least 5 V/div.

**Bandwidth**—DC coupled, DC to at least 1 MHz. AC coupled 50 Hz or less to at least 1 MHz.

**Input R and C**—1 M $\Omega$  within 2%, approx 70 pF.

**Maximum Input Voltage**—350 V (DC + peak AC).

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Please refer to Reference page



- 1  $\mu$ s/DIV to 100 ms/DIV CALIBRATED TIME BASE
- EXTERNAL HORIZONTAL INPUT

The 5B13N is a low-cost, general-purpose time base for the 5103N Oscilloscope System. Sweep rates are selected by push button. The 5B13N is for applications such as basic laboratory use by students, production testing, scientific research and other areas where 100 ms/div to 1  $\mu$ s/div sweep rates are needed.

### CHARACTERISTICS

**Sweep Rates**—1  $\mu$ s/div to 100 ms/div within 5% in 6 calibrated decade steps. A lighted multiplier control provides continuous uncalibrated variation between steps, and extends the push-button selected rate to at least 1 s/div.

### TRIGGERING

| COUPLING    | SENSITIVITY AND FREQUENCY RANGE                             |
|-------------|---|
| AC          | 0.4 div from 50 Hz to 100 kHz, increasing to 1 div at 1 MHz |
| Preselected | 200 mV from 50 Hz to 1 MHz                                  |

**External Trigger Input**—Maximum input voltage is 200 V (DC + peak AC). Input R and C is approx 100 k $\Omega$  paralleled by approx 1000 pF. Trigger level voltage range is +1.5 V to -1.5 V.

### EXTERNAL HORIZONTAL INPUT

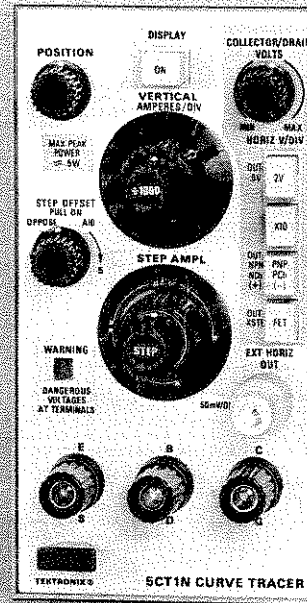
**Deflection Factor**—50 mV/div, accurate within 5%. A continuously variable deflection factor multiplier provides variation between 50 mV/div and 0.5 V/div.

**Bandwidth**—50 Hz or less to at least 250 kHz.

**Input R and C**—Approx 50 k $\Omega$ , approx 1000 pF.

**Maximum Input Voltage**—200 V (DC + peak AC).

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- TESTS SEMICONDUCTOR DEVICES to 0.5 W
- 10 nA/DIV to 20 mA/DIV VERTICAL DEFLECTION FACTORS
- 0.5 V/DIV to 20 V/DIV HORIZONTAL DEFLECTION FACTORS

The 5CT1N Curve Tracer is a plug-in unit used in TEKTRONIX 5100-Series Oscilloscope Systems for displaying characteristic curves of semiconductor devices to power levels up to 0.5 watts. The plug-in operates in either vertical compartment of the mainframe. Horizontal deflection is achieved through a front panel source which drives the external input of either a vertical or horizontal plug-in unit installed in the mainframe's horizontal compartment.

A variable collector/drain sweep produces a maximum peak voltage of at least 250 volts; a base/gate step generator produces up to 10 calibrated current or voltage steps. Ranges of step amplitudes are 1  $\mu$ A/step to 1 mA/step for current and 1 mV/step to 1 V/step for voltage. Maximum power output is 0.5 watts. In addition, the unit has a vertical display amplifier with deflection factors ranging from 10 nA/div to 20 mA/div and a horizontal display amplifier with deflection factors ranging from 0.5 V/div to 20 V/div.

see complete description page 182-183.