Tektronix®

5B12N DUAL TIME BASE

INSTRUCTION MANUAL

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

5B12N
DUAL
TIME BASE

INSTRUCTION MANUAL

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

Serial Number ____________________

070-1141-00
Product Group 52

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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 general safety information in this part of the summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

Terms In This Manual

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

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

Terms As Marked on Equipment

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

Symbols In This Manual

⚠ This symbol indicates where applicable cautionary or other information is to be found.

Symbols As Marked on Equipment

⚡ DANGER — High voltage.

⏚ Protective ground (earth) terminal.

⚠ ATTENTION — refer to manual.

Power Source

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Grounding the Product

This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the product input or output terminals. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Danger Arising From Loss of Ground

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electric shock.

Use the Proper Fuse

To avoid fire hazard, use only the fuse of correct type, voltage rating and current rating as specified in the parts list for your product.

Refer fuse replacement to qualified service personnel.

Do Not Operate in Explosive Atmospheres

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

Do Not Operate Without Covers

To avoid personal injury, do not operate this product without covers or panels installed. Do not apply power to the plug-in via a plug-in extender.

SERVICE SAFETY SUMMARY

FOR QUALIFIED SERVICE PERSONNEL ONLY

Refer also to the preceding Operators Safety Summary.

Do Not Service Alone

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

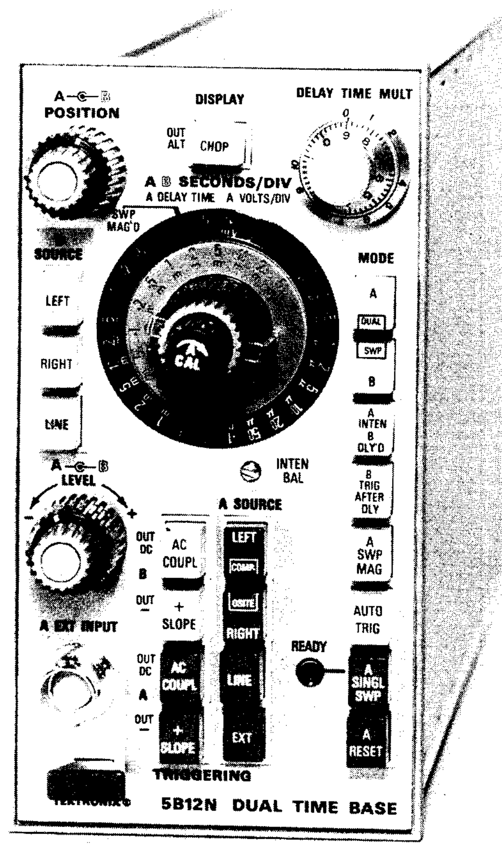
Use Care When Servicing With Power On

Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections and components while power is on.

Disconnect power before removing protective panels, soldering, or replacing components.

Power Source

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.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TRIGGERING
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.

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 5400-series oscilloscope, 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 5400-series 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 completed, the sweep generator is "locked out" until again reset. To prepare the circuit for another single-sweep display, press the RESET button again.

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. 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 dual sweep operation, the sweep displays are viewed 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.

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.

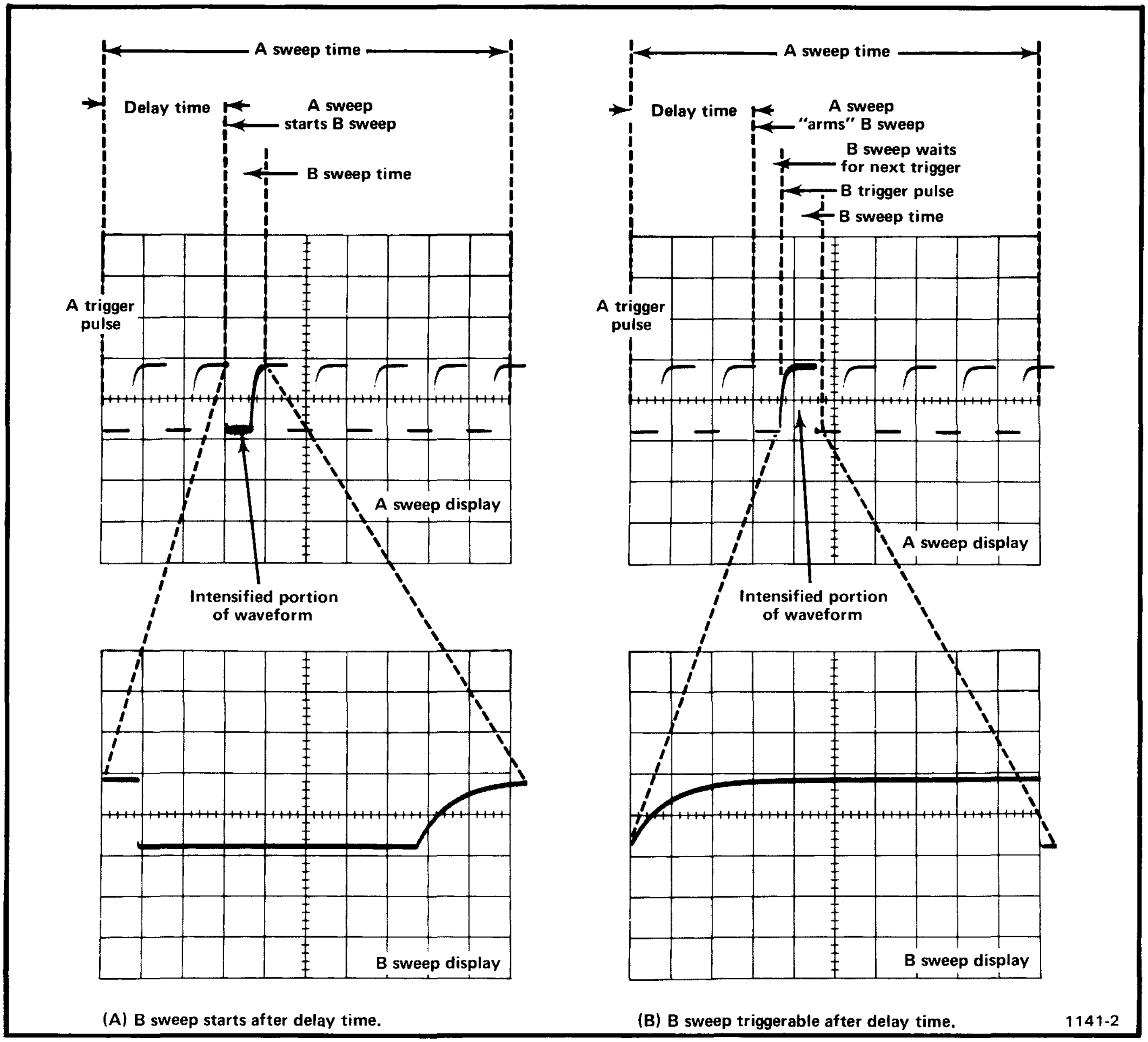
When the B TRIG AFTER DLY button is pushed in, the delayed sweep mode is modified to permit a triggered B sweep which is delayed for a selected time (see Fig. 2-1B). Instead of starting exactly at the point selected by the DELAY TIME MULT dial, the B sweep starts later when a trigger pulse is received. 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).



(A) B sweep starts after delay time.

(B) B sweep triggerable after delay time.

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.

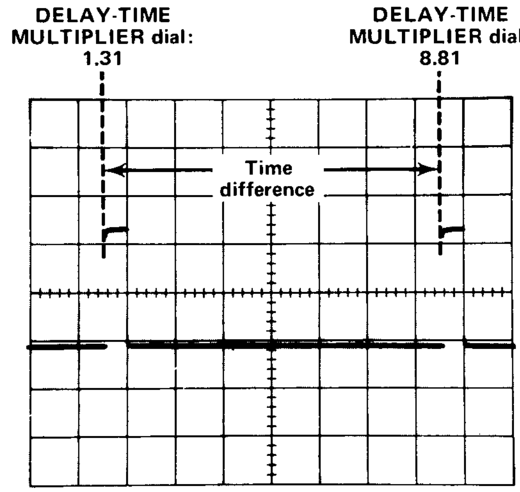
6. Subtract the first dial setting from the second and multiply the results by the A SECONDS/DIV switch setting. This is the time interval between the pulses.

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:

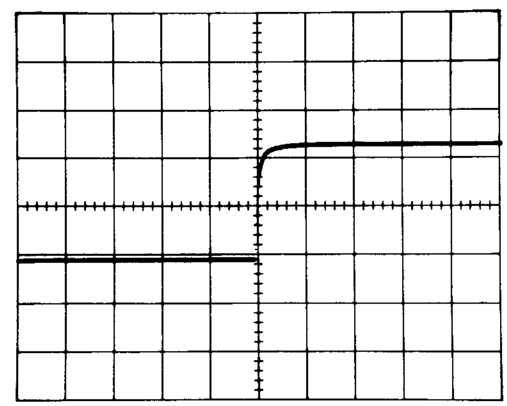
Time Difference (delayed sweep) =

(8.81 − 1.31) X 0.2 ms = 1.5 milliseconds

The time difference is 1.5 milliseconds.



(A) A Display.



(B) B (DELAYED SWEEP) display.

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.

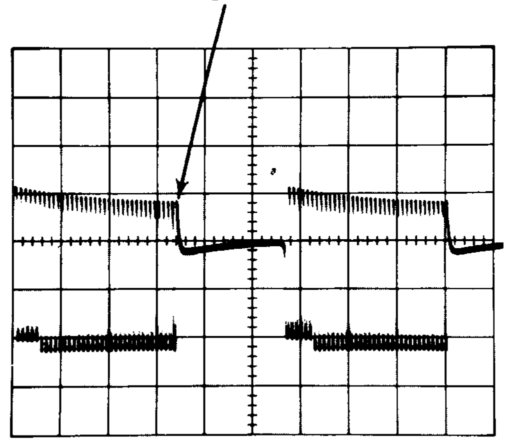
5. The magnified portion of the A sweep is displayed on the B sweep. Accurate time measurements can be made from the display in the conventional manner. Sweep rate of the magnified portion is determined by the setting of the B SECONDS/DIV switch.

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 μs is:

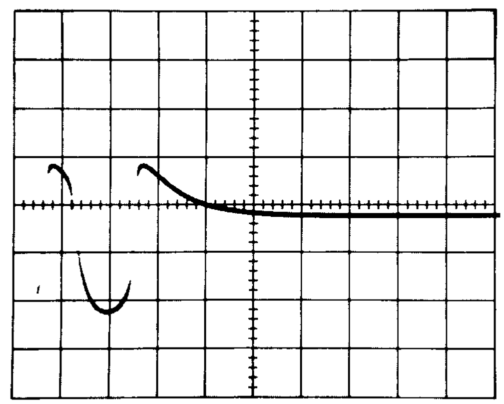
$$\text{Apparent Magnification} =$$

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

The apparent magnification is 100 times.



(A) A sweep display.



(B) Delayed sweep display.

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

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.

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.

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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.

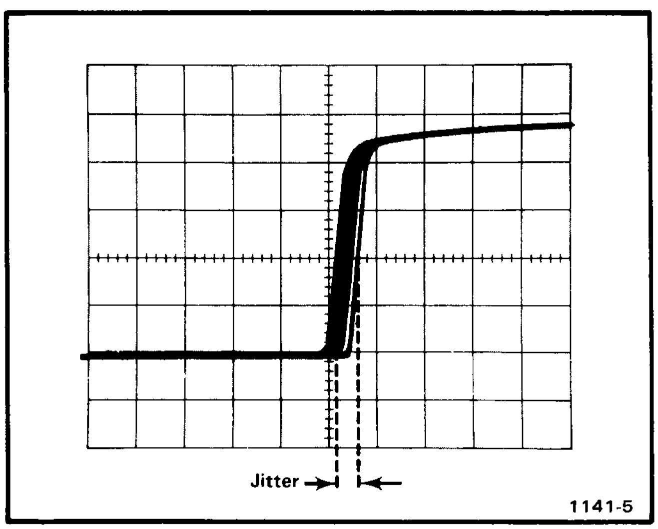

Fig. 1-4. Measuring pulse jitter.

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.) Exclude the first 800 ns of all sweep rates.

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).

REPACKAGING FOR SHIPMENT

If the Tektronix instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag showing: owner (with address) and the name of an individual at your firm that can be contacted. Include complete instrument serial number and a description of the service required.

Save and re-use the package in which your instrument was shipped. If the original packaging is unfit for use or not available, repackage the instrument as follows:

Surround the instrument with polyethylene sheeting to protect the finish of the instrument. Obtain a carton of corrugated cardboard of the correct carton strength and having inside dimensions of no less than six inches more than the instrument dimensions. Cushion the instrument by tightly packing three inches of dunnage or urethane foam between carton and instrument, on all sides. Seal carton with shipping tape or industrial stapler.

The carton test strength for your instrument is 200 pounds.

WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO. REFER TO OPERATORS SAFETY SUMMARY AND SERVICE SAFETY SUMMARY PRIOR TO PERFORMING ANY SERVICE.

SECTION 2
THEORY OF OPERATION

Introduction

This section of the manual contains an electrical description of the circuits in the 5B12N Dual Time Base plug-in unit. An overall block diagram and complete schematic diagrams are given on pullout pages in Section 4 of this manual. A complete description of A Time Base is provided and, since B Time Base very closely resembles A Time Base, only the significant differences are discussed.

BLOCK DIAGRAM DESCRIPTION

A Time Base

The Input Switching selects the A sweep-triggering signal from any one of four sources. It also provides a choice of AC or DC coupling or triggering and display signals to the Trigger Preamplifier System. The Trigger Preamplifier serves two purposes: it provides current drive to initiate a trigger in the Sweep Logic portion of the A Sweep Generator, and it provides a high-impedance input for the external-signal Amplifier.

The A Sweep Generator circuit produces a sawtooth voltage which is amplified in the display unit to provide sweep deflection on the CRT. Positive- and negative-going gates are produced at the same time the sawtooth is being produced to perform sweep-related functions such as CRT sweep-retrace blanking, etc. The A Sweep Generator can be operated in any one of several modes, including the normal triggered mode, the auto-triggered (bright baseline) mode, or the single-sweep mode.

The Amplifier allows an externally-applied signal to be displayed. For this mode of operation, the Trigger Preamplifier is used as a high-impedance input which permits both AC and DC coupling. The internal triggering inputs are grounded and the A Sweep Generator is disabled (including the CRT blanking gate). The input attenuator permits selection of two deflection factors. The Amplifier has a X1 gain, and the Variable control provides a continuously variable 1X to 10X attenuation of the input signal.

The Position Driver provides positioning current for both time-base sweep signals and amplified signals. This stage is controlled by the front-panel A POSITION control.

B Time Base

The Input Switching selects the B sweep triggering signal from one of three sources. B sweep trigger is fed directly through a Trigger Comparator to the Sweep Logic portion of the B Sweep Generator.

The Lockout Switching is used during the non-delayed modes (A only, B only, and A alternated with B) to lock out whichever sweep is not running.

The Output Switching supplies the A unblanking, B unblanking, A sweep or B sweep to the mainframe.

DETAILED CIRCUIT DESCRIPTION

Seconds/Div (Time Base) Mode

Display Switching

Alternate or Chopped time-shared switching of the vertical plug-ins and amplifier channels is selected at the time-base unit. The CHOP switch, S471, selects either CHOP (button pushed in) or ALT (button out).

Trigger Input

The source from which a sweep-triggering signal is obtained is selected by the TRIGGERING SOURCE switch, S110, which is a self-cancelling four-pushbutton switch. The triggering signal may be selected from internal, line, or external sources.

The internal triggering signal is obtained from either the left vertical plug-in, the right vertical plug-in, or from both as a composite triggering signal. Amplitude of the internal triggering signal is about 250 millivolts per division of display.

The line triggering signal is obtained from a network in the power supply circuit of the associated oscilloscope. A sample of the line frequency is applied via S110C to the input gate of Q128A.

External triggering signals applied to the EXT INPUT connector, J101, can be used to produce a trigger when the EXT button, S110D, is pushed in.

Trigger Coupling

The triggering signal may be capacitive coupled (AC COUPL) or direct coupled (DC). Coupling is selected by pushbutton switch S114C. When the AC COUPL button is pressed, coupling capacitors C102 and C114 are placed in the circuit. These capacitors block any DC component of the signal while coupling signals of 50 hertz (−3 dB point) and higher to the input. When DC coupling is selected (button out), these capacitors are shorted, allowing the triggering signal to be direct-coupled to the gate of Q128A.

Trigger Preamplifier

Q128A, Q128B, Q132, and Q133 form a voltage comparator system to select the amplitude of a triggering signal at which a sweep trigger can be initiated. The triggering signal is applied to the gate of Q128A and a DC level established by R150, TRIGGERING LEVEL, is applied to the gate of Q128B. When the two halves of the comparator are balanced, the voltage at Q132 collector is zero and the current through R139 is zero. When the signal passes through the DC level, the conduction of the two halves of the comparator is shifted; and when the collector of Q132 moves away from zero volts (positive or negative) far enough to produce about 100 microamperes through R139, a trigger is initiated in U160.

A Sweep Generator

The Sweep Generator circuit produces a linear sawtooth voltage which is used to provide sweep deflection in the associated oscilloscope. It also produces positive-going and negative-going gates to perform sweep-related functions such as time-shared switching and CRT unblanking in the oscilloscope.

The Sweep Generator circuit is composed of two integrated circuits, Sweep Logic U160 and Miller Integrator U210, and their associated discrete circuit components. The primary functions of these components are trigger slope selection and pulse forming, sawtooth start and stop, hold-off and single sweep lockout, and bright baseline generation. Table 2-1 discusses each terminal and its function. All terminals are digital unless noted otherwise, and positive logic is employed. Pins not used are grounded.

The Sweep Mode switch, S171, allows three modes of operation: Normal Triggered Mode (AUTO TRIG button S171A out), Normal Auto and Bright Baseline Mode (AUTO TRIG button pushed in), and Single Sweep Mode (A SINGL SWP button S171B pushed in). First to be discussed is the Normal Triggered Mode.

TABLE 2-1

SWEEP GENERATOR INPUT-OUTPUT

Sweep Logic U160

Terminal		Function
1	End Sweep	Current (logical 1) for at least 20 nanoseconds ends sweep. Current continuous locks out sweep. No input (logical 0) allows U160 to operate.
2	Not Used	Grounded (chassis ground).
3	Not Used	Grounded (chassis ground).
4	Trigger Input	Analog input, low impedance. Accepts analog current triggering signal. Trigger threshold: 0 current, 200 μA P-P hysteresis.
5	Slope Select	Logical 1 permits trigger to be initiated on the positive slope of a triggering signal; logical 0 permits trigger to be initiated on the negative slope.
6	Single Sweep Control	Logical 1 permits repetitive sweep. Logical 0 allows only a single sweep to be produced unless reset (see pin 7).

TABLE 2-1 (cont)

Terminal		Function
7	Single Sweep Reset	Current into pin (logical 1) for at least 20 nanoseconds resets single sweep system and allows sweep to be retriggered. After reset occurs, C167 and R167 permit this input to return to ground (logical 0).
8	GND/Substrate	Provides ground reference for the device.
9	READY Lamp Output	Provides power (0.4 volt at a maximum of 80 mA) to READY lamp when sweep is ready for triggering (Single Sweep Mode). Removes power, extinguishing lamp upon receipt of sweep trigger. Open (+5 volts maximum) at other times.
10	Lockout	Logical 1—sweep is locked out (cannot be started). Logical 0—lockout off.
11	Holdoff Timing	Connects timing components which set trigger lockout period after end of sweep. Capacitor discharges as soon as sweep is started, and timing starts at end of sweep as capacitor charges. When capacitor charges to upper threshold (+3.5 volts), new sweep can be produced either upon receipt of next trigger or if pin 12 is above its upper threshold (see pin 12).
12	Bright Baseline Timing/Off	Used in Auto Triggered Mode to connect timing components which set bright baseline off period after trigger recognition. If triggering signal is absent of occurring at a rate less than 15 hertz, capacitor charges toward +3.5-volt threshold. Above this level, U160 is conditioned to provide a free running sweep at a rate determined by the sweep timing and holdoff RC. As soon as a trigger arrives at pin 4 of U160, pin 12 is driven to ground and C179 is discharged.
13	Bright Baseline Control	Current into pin (logical 1) for ⩾20 nanoseconds keeps pin 12 at ground, holding Bright Baseline off. Baseline remains off for one timing period after current level is removed. No input (logical 0) allows Bright Baseline to function (see pin 12).
14	+ Gate Output	Provides a +5-volt source through 2 kilohms (logical 1) during sweep, driving current into pin 1 of U210. Logical 0 (+0.4 volt at 5 mA maximum) when sweep is not being produced.
15	– Gate Output	Logical 0 (+0.4 volt at 5 mA maximum) during sweep. Provides a +5-volt source through 2 kilohms (logical 1) when sweep is not being produced. Maximum delay after fast-rise trigger initiation is 25 nanoseconds.
16	Power Supply	Supply voltage of +5 volts is applied.

TABLE 2-1 (cont)

Miller Integrator U210

Terminal		Function
1	Sweep Gate In	Current into pin results in sawtooth voltage at pin 8.
2	Oscillation Suppressor	Connects discrete components to prevent oscillation of the Miller Integrator.
3	Ground	Provides ground reference to the device.
4	Delay Comparator Out	Provides delayed gate to start B sweep.
5	End Delayed Gate	Controls delayed gate output from pin 4. Logical 1 at pin 5 enables an output from pin 4; logical 0 disables output from pin 4.
6	DELAY TIME MULT Level	Connects voltage comparator inside U210 to establish the level at which the delayed gate is initiated.
7	Power Supply	Supply voltage of +15.5 volts applied.
8	Sawtooth Output	Produces sweep sawtooth voltage when current is gated into pin 1. Sawtooth is positive going, with amplitude of 0 to +10 volts.
9	Timing Current Input	Connects timing components which determine sweep rate.
10	Substrate	Supply of 13 milliamperes applied.

Normal Triggered Mode

The Trigger Preamplifier circuit provides current drive to pin 4 of U160 at selected levels on both the positive- and negative-going slopes of the triggering signal. The SLOPE switch, S114D, controls the level at pin 5 to determine the slope at which the sweep trigger is initiated.

When the trigger is inititated in U160, a positive transition occurs at pin 14. This output will remain high until the sweep terminates. At the same time, a negative gate is produced at pin 15 which is used to unblank the CRT in the oscilloscope.

Integrated circuit U210 is a Miller Integrator, a type of operational amplifier in which the feedback element is the timing capacitor. Before a positive gate is received from U160, timing capacitor C224, C225, or C229 has essentially no charge, as it is clamped by a network inside U210, and current through the timing resistor network R225-R238 is input to pin 9 of U210. When the positive gate arrives from U160, the current is switched into the timing capacitor and it begins to charge. The current is nearly constant, and since pin 9 is the operational amplifier null point, a linearly increasing voltage (sawtooth) is produced at pin 8. The rate of the sawtooth rise is a function of the constant current through the timing resistors and the capacitance of C224, C225, or C229.

Pins 6 and 4 are utilized for delay time multiplier and comparator output functions (see Delayed Sweep Mode description). Grounded base amplifier Q270 provides end-sweep level to pin 1 of U160. When pin 8 of U210 reaches about 10 volts, Q270 turns on which lifts its collector (tied to pin 1 of U160), and terminates the gate. Capacitor C270 helps shape a fast-rise end-sweep pulse to speed up the switching action.

A short-duration trigger-lockout period (to allow the sweep circuits to stabilize when the sweep terminates) is provided by the holdoff network at pin 11 of U160. For U160 to function, the voltage at pin 11 must be at least +3.5 volts. When the sweep starts, the voltage at pin 11 is driven to ground, discharging holdoff capacitors C154, C155, or C156. The capacitors begin to charge as the sweep progresses, and continue to charge as the sweep terminates. The time between sweep termination and the time it takes pin 11 to reach the +3.5-volt threshold is the holdoff period.

The timing and holdoff RC components are selected by the SECONDS/DIV switch, S160. The A Swp Timing potentiometer, R240, allows calibration of this circuit for accurate timing when the Variable control, R235A, is in the CAL detent position. The Variable control provides uncalibrated, continuously variable timing.

Normal Auto Triggered Mode and Bright Baseline Operation

Operation of the Sweep Generator in the Normal Auto Triggered Mode is the same as that described for the Normal Triggered Mode when a trigger is present and occurring at a rate greater than 15 hertz. However, when a trigger is not present within a specified time, a free-running reference trace, or Bright Baseline, is produced. This is accomplished as follows:

When the AUTO TRIG button is pushed in, R172 is disconnected from +5 volts, removing the Bright Baseline lockout current from pin 13 of U160. This allows the Bright Baseline timing circuit R179-C179 to function. Each time a trigger is initiated in U160, pin 12 is driven to ground and C179 is discharged. C179 immediately begins to charge again. If the capacitor is allowed to charge above the +3.5-volt threshold level, U160 is conditioned to provide a positive gate at pin 14 and a negative gate at pin 15 as soon as the holdoff period is completed (when pin 11 rises above its threshold). The sweep will therefore free run at a rate determined by the timing and holdoff networks.

Single Sweep Mode

Operation of the Sweep Generator in the Single Sweep Mode is similar to operation in the Normal Triggered Mode. However, after one sweep has been produced, further triggers are locked out in U160 until the RESET button is pressed.

When A SINGL SWP button S171B is pushed, the following conditions are established in U160: +5 volts is applied to R172 to drive current into pin 13, keeping pin 12 at ground and holding the Bright Baseline feature off. Pin 6 is grounded, requiring U160 to be manually reset. The READY lamp, DS270, is connected to pin 9 to indicate that the system is reset and triggerable. As soon as the system is triggered, the READY lamp is extinguished.

The system is reset when A RESET button S171C is pushed. +5 volts is applied to differentiating network C167-R167. The positive spike appearing at pin 7 resets the system.

Sweep Magnification and Positioning

A X10 magnification of the sweep is achieved by changing the attenuation ratio of the output sawtooth. For an unmagnified sweep, R241, R243, and R244 provide a 20X attenuation of the sawtooth, reducing it from a +10-volt amplitude to a +0.5-volt amplitude. The deflection sensitivity of the associated oscilloscope is such that this amplitude will give one screen width of deflection, provided the 5B12N output sawtooth is centered about ground, which corresponds with screen center.

When the A SWP MAG button, S470E, is pressed, R243 is disconnected, changing the attenuation to 2X and increasing the sawtooth amplitude to 5 volts. Since only one-tenth of this amplitude is accepted by the oscilloscope, the displayed segment appears as a X10 magnification. Also, the knob-skirt readout is changed by a factor of 10 (DS248 turns off and DS249 lights) to indicate the magnified sweep rate.

R245A, A POSITION, provides an adjustable change in the conduction of Q246 to alter the DC level of the output signal. Positioning range is sufficient to move any portion of a magnified sweep into the on-screen window.

Volts/Div (Amplifier) Mode

To operate the instrument in the amplifier mode, the SECONDS/DIV switch is rotated counterclockwise into one of the two VOLTS/DIV positions. In this condition, the internal and line triggering inputs are grounded, the sweep generator circuit is disabled (including the CRT blanking gate), and the output of the Trigger Preamplifier is connected through a grounded base amplifier and made available to output pin A7.

Signal Input

External voltage signals to be displayed are applied to the A EXT INPUT connector. These signals may be capacitive coupled (AC COUPL) or direct coupled (DC). Coupling is selected by pushbutton switch S114C. When the AC COUPL button is pressed, C102 is placed in the circuit to couple signals of about 50 hertz (−3 dB point) and higher to the input. C102 blocks any DC component of the signal. When the button is out (DC), capacitor C102 is shorted and the signal is direct-coupled to the input.

The signal by-passes the triggering source inputs via the closed contacts of the VOLTS/DIV switch; in the 50 mV/DIV position, the signal is passed directly to the gate of Q128A and, in the 500 mV/DIV position, the signal is passed through a frequency-compensated 10X divider to the gate of Q128A.

Input Stage

Q128A, Q128B, Q132, and Q133 form a non-inverting operational amplifier which is operated as a unity-gain voltage follower to isolate the amplifier stage from the high impedance input circuitry. As a signal is applied to the gate of Q128A, an in-phase signal of essentially the same amplitude is produced at the collector of Q132. The TRIGGERING LEVEL potentiometer, R150A, is disconnected from the gate of Q128B, allowing the gain of the stage to be determined by the ratio of R135 and R136.

Output Stage

The output from the collector of Q132 is connected to the emitter circuit of Q144, which is a grounded-base amplifier. The signal produced at the Q144 collector is in phase with the applied signal. Gain of the stage is about one with the Variable Volts/Div potentiometer, R235B, in the detent position. As R235B is varied, more resistance is added to the emitter circuit, decreasing the gain. The output signal is made available to the deflection system of the associated oscilloscope through pin A7 of the plug-in connector.

Time-Base and Deflection Factor Switching

The SECONDS/DIV OR VOLTS/DIV switch, S160, is made up of a series of cam lobes which engage and disengage various contacts at different positions of the switch. The switch selects any of 21 calibrated sweep rates from 1 μs/Div to 5 s/DIV, or either of two calibrated deflection factors, 50 mV/DIV or 500 mV/DIV, for external voltage signals.

Either of two lamp bulbs located behind the knob skirt of the switch illuminates the selected rate to provide a direct readout. Normally, DS248, which is physically located behind the upper right portion of the knob skirt, is lit. Pushing the A SWP MAG button automatically changes the readout by a factor of 10 (i.e., turns off DS248 and lights DS249).

Table 2-2 lists the function of each switch contact. Those contacts that are engaged at any given position of the switch are shown by black dots on the switch logic portion of the schematic diagram.

TABLE 2-2

Contact	Function
1-6	Input switching.
7, 8	Trigger Preamplifier output switching.
9	Connects/disconnects Triggering Level control.
10	Sweep enable/disable.
11, 12	Holdoff timing RC switching.
13	Blanking gate enable/disable.
14-20	Sweep timing RC switching.
21, 22	Time-base or amplifier output selection.

Delayed Sweep Mode

Trigger Comparator

The B Time Base trigger comparator, Q315/Q320, differs from the A Time Base because it does not have to drive from an external input nor present a display. The input to Q315 is near ground as is the input to pin 4 of U360; thus, a 5.1-volt zener diode is employed between Q315 and Q320 to provide dynamic range capability.

Delay Pickoff

Delay pickoff is accomplished through pin 6 of Miller integrator U210, in the A Time Base circuitry. DELAY TIME MULT R205 applies 0 to 10 volts to pin 6, which is a delay control input to the comparator section of U210. When the A sweep voltage reaches the voltage set on the DELAY TIME MULT control, a fast-rise transition appears at pin 4 of U210 and is coupled through C367 to pin 7 and pin 2 of U360 in the B Time Base. U360 is reset (pin 7) and triggered (pin 2) by the same transition.

When B TRIG AFTER DLY S470D is pressed, pin 2 is grounded, which resets B sweep to wait for the next trigger through the normal trigger path.

Pin 5 of U210 controls the output from pin 4. +5 volts is applied to pin 5 when A INTEN B DLYD S470C is pressed,

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which enables an output from pin 4. However, when in a non-delayed mode, a logic 0 level is present at pin 5, and no output is enabled from pin 4.

Lockout Switching

Lockout switching is provided by Q480 and Q485 to lock out whichever sweep is not running in the non-delayed modes; i.e. A only, B only, or A alternated with B. However, lockout switching is not required in the delayed sweep or chopped mode, since both time bases must run at the same time. Thus, Q480 and Q485 are disabled when A INTEN B DLYD S470C is pressed.

B Sweep Generator

When pressed, A INTEN B DLYD removes +5 volts from pin 6 of U360, which is then in the delayed or single sweep mode. If U360 is being triggered automatically through AUTO TRIG S171A, it is disabled to prevent the B sweep from free-running each time it is reset.

A sweep is intensified during B sweep by using the —gate from pin 15 of U360 through S470C to B9.

S470C also disables the alternate pulse provided by network C478/R478/CR478 at the end of B sweep. A comparable network in the A Time Base, composed of C475/R475/CR475 also provides an alternate pulse at the end of A sweep. In the delayed sweep mode both sweeps must run simultaneously, with A sweep being the controlling time base. Thus, only the alternate pulse from A Time Base is used with the B alternate pulse switched out.

Output Switching

Output switching is accomplished through Q490 and Q495 which drive Q465, Q455, Q450 and Q260. The series elements in the switching circuitry are zero-bias FET's that disconnect the A unblanking (Q465), B unblanking (Q455), A sweep (Q260) or B sweep (Q450).

These FET's are essentially variable resistors that look like 200 ohms to all elements at zero bias ("on" state) or several megohms ("off" state) when gated. Q260, the A sweep switch, is in parallel with Q450, the B sweep switch. Thus, one or the other is on—but never both.

When B, S470B, is pressed, A is cancelled and the base of Q490 is biased positive with respect to Q495. This brings the collector of Q490 down and gates Q465 off. Consequently, there is no A unblanking signal at A9. Meanwhile, the collector of Q490 also gates Q260 off through CR491 and there is no A sweep at A7. Conversely, the collector of Q495 is up, which gates Q455 on and provides a B unblanking signal at B10. Q450 is also gated on through CR450 and R450, which provides a B sweep signal at A13.

When A, S470A, is pressed, the previous conditions are generally reversed with B unblanking and B sweep turned off and A unblanking and A sweep turned on.

When both A and B are pressed for dual-sweep operation, the base of Q490 is at −15 volts. Now, the operation of switch Q490/Q495 is subject to the drive on the base of Q495. Chop or alternate drive, depending on mode selected, is supplied from the mainframe through B21 and R497. Switching between A and B sweep and unblanking is at a 50 kHz rate in chopped mode, or at a divide-by-4 sequence of the sweep rate in alternate mode. A counter in the mainframe counts the alternate pulses from B15 when in the alternate mode, while a chop clock in the mainframe provides the 50 kHz chopping drive in chopped mode.

Scan by Zenith

SECTION 3
CALIBRATION

Introduction

This section of the manual contains a procedure to return the circuits of the 5B12N to within their designed operating capabilities. Calibration is generally required after a repair has been made, or after long time intervals in which normal aging of components may affect instrument accuracy. For initial inspection, verify instrument operation by performing the procedures described under General Information in Section 1.

Instrument Maintenance

Before complete calibration, thoroughly clean and inspect this instrument as outlined in the Maintenance section of the Oscilloscope System manual. Also, the system manual contains information for general maintenance of this instrument, including preventive maintenance, component identification and replacement, etc.

Service Available

Tektronix, Inc. provides complete instrument repair and calibration at local Field Service Centers and at the Factory Service Center. Contact your local Tektronix Field Office or representative for further information.

TEST EQUIPMENT REQUIRED

General

The following test equipment and accessories, or the equivalent, are required for complete calibration of the 5B12N. Specifications given for the test equipment are the minimum necessary for accurate calibration. Therefore, some of the specifications listed may be less rigorous than the actual performance capabilities of the test equipment. All test equipment is assumed to be correctly calibrated and operating within the listed specifications.

Calibration Equipment Alternatives

If other test equipment is substituted, control settings or setup may need altering to meet the requirements of the equipment used. Detailed operating instructions for the test equipment are not given in this procedure. Refer to the instruction manual for the test equipment if more information is needed.

Special Calibration Fixtures

Special Tektronix calibration fixtures are used in this procedure only where they facilitate instrument calibration. These special fixtures are available from Tektronix, Inc. Order by part number through your local Tektronix Field Office or representative.

Test Instruments

1. 5100-series oscilloscope system. For this procedure, a 5110 Oscilloscope with 5A15N, 5A21N, and 5B10N plug-in is used.

2. Sine-wave generator. Frequency, 2 Hz to 2 MHz; output amplitude, about 0.5 V to at least 20 V P-P. Tektronix FG 503 Function Generator recommended (requires a TM 500-series power module).

3. Time-mark generator. Marker outputs, 0.1 μs to 5 s; marker accuracy, within 0.1%. Tektronix TG 501 Time Mark Generator recommended (requires a TM 500-series power module).

4. Standard amplitude calibrator. Required only for checking amplifier mode. Frequency, about 1 kHz; square-wave output amplitude, 0.5 V to 5 V, within 0.25%. Tektronix PG 506 Calibration Generator recommended (requires a TM 500-series power module).

5. 1X passive probe. Tektronix P6101 Passive Probe.

Accessories

1. Coaxial cable. Impedance, 50 Ω; length, 42 inches, connectors, bnc. Tektronix Part No. 012-0057-01.

2. Dual-input cable. Provides matched signal paths to the vertical and time-base external inputs. Tektronix Calibration Fixture 067-0525-01 recommended.

3. Plug-in extension for the 5100-series oscilloscope system. Tektronix Calibration Fixture 067-0645-03. (Not mandatory for this procedure.)

4. Termination. Impedance, 50 Ω; accuracy, within 2%; connectors, bnc. Tektronix Part No. 011-0049-01.

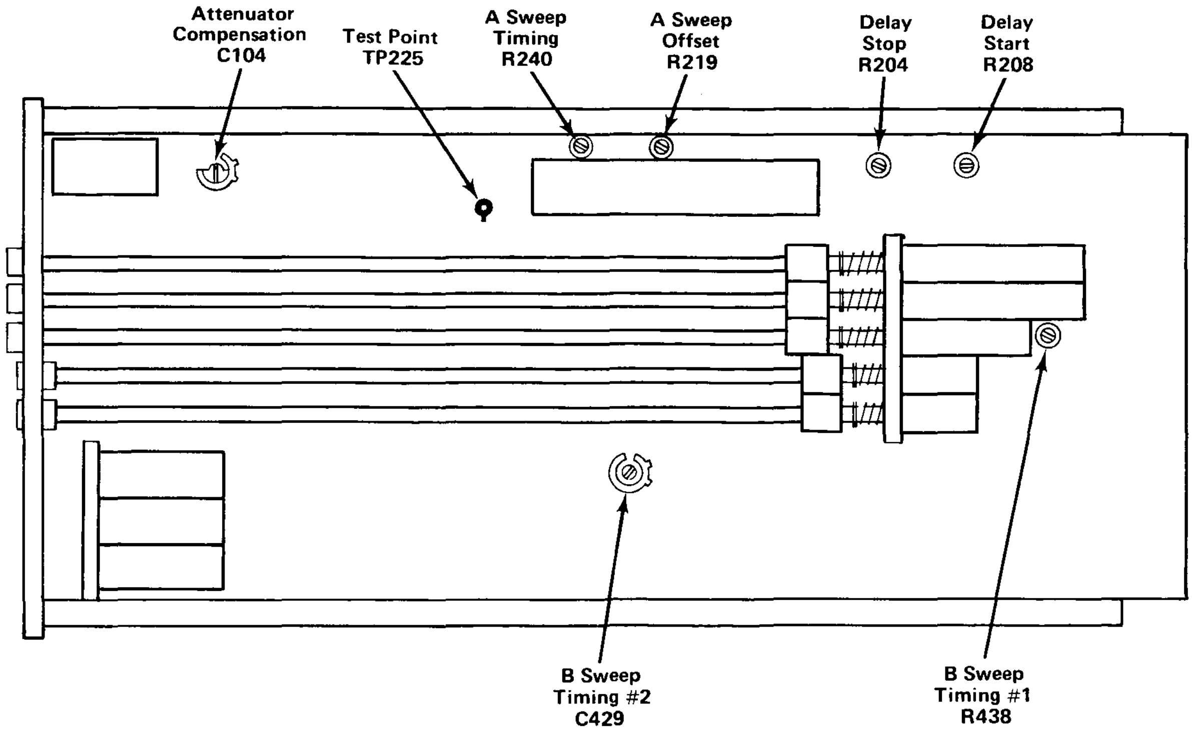


Fig. 3-1. Location of internal controls.

PROCEDURE

Preparation

1. Remove the dust cover from the right side of the 5B12N and remove the cabinet panel from the 5100-series oscilloscope. Insert the 5B12N into the right plug-in compartment; the 5A15N in the left compartment, and the 5A21N in the middle compartment. The plug-in extender is convenient to use, but is not mandatory for this procedure.

2. Check the rear of the oscilloscope to ensure that the indicated line voltage and the line voltage source are the same. Connect the oscilloscope to the power source. Set the controls as described under Initial Control Settings. Refer to Fig. 3-1 for location of internal adjustments and test points.

NOTE

This instrument should be calibrated at an ambient temperature between +20°C and +30°C (+68°F and +86°F) for best accuracy.

Initial Control Settings

NOTE

Do not preset internal controls unless they are known to be significantly out of adjustment, or unless repairs have been made in the circuit. In these instances, the internal controls can be set to midrange.

5B12N

A SECONDS/DIV	1 m
Variable (CAL)	CAL (fully cw)
Display Mode	A
Sweep Mode	AUTO TRIG
A TRIGGERING	+ SLOPE
All other buttons	Out

Amplifier (5A21N)

Display	On
Volts/Div	5 m
+ and — Input Coupling	Gnd
All other buttons	Out

Amplifier (5A15N)

Display	Off

1. A Sweep Offset (R219)

Position the trace to graticule center. Connect 1X Probe between the + Input of the Amplifier plug-in installed in the middle compartment and TP225. Release the + Input Gnd button and adjust R219 (A SWP OFFSET) so that the trace is at graticule center. Remove the probe.

2. A Sweep Timing (R240)

Change the following control settings:

Amplifier (5A21N)

Display	Off

Amplifier (5A15N)

Display	On
Input Coupling	DC
Volts/Div	.5

5B12N

A SOURCE	LEFT

Apply 1 ms markers from the Time-Mark Generator output through a 50 Ω cable to the input of the Amplifier plug-in installed in the left compartment. Adjust A LEVEL for a stable display. Adjust R240 (A SWP TIMING) for exactly 1 time-mark/div.

3. A Sweep Length

Position the second time-mark to the first graticule line. Check that the sweep ends within the last graticule division (see Note).

NOTE

Graticule divisions are numbered from one through ten with the first division between the zero graticule line (left edge of graticule) and the first graticule line. The last graticule division, then, is between the ninth and tenth graticule lines.

4. Variable (CAL) Range

Set A SECONDS/DIV to .2 m and turn CAL fully ccw. Position the first time-mark to the first graticule line and check for at least 6 time-marks.

5. POSITION Range

Return CAL to detent (calibrated). Check that the end of the sweep will position to the left of the center graticule line.

6. A SECONDS/DIV Accuracy

Release AUTO TRIG button. Apply markers from Time-Mark Generator as specified in Table 3-1. Adjust A LEVEL for a stable display. Check normal and magnified sweep accuracy over middle 8 graticule divisions as described in Table 3-1. Exclude the first 800 ns of all sweep rates.

TABLE 3-1

SECONDS/DIV switch setting	Time marker selector	CRT display (Markers/ division)	Accuracy (measured between first and ninth graticule lines)
1 μ	1 μs	1	Normal sweep: ±3% (0.24 div) Magnified sweep: ±4% (0.32 div)
2 μ	1 μs	2	
5 μ	5 μs	1	
10 μ	10 μs	1	
20 μ	10 μs	2	
50 μ	50 μs	1	
.1 m	.1 ms	1	
.2 m	.1 ms	2	
.5 m	.5 ms	1	
1 m	1 ms	1	
2 m	1 ms	2	
5 m	5 ms	1	
10 m	10 ms	1	
20 m	10 ms	2	
50 m	50 ms	1	
.1	.1 s	1	
.2	.1 s	2	
.5	.5 s	1	
1	1 s	1	
2	1 s	2	Normal sweep: ±4% (0.32 div) Magnified sweep: ±5% (0.4 div)
5	5 s	1	

7. B Sweep Timing (R438)

Change the following control settings:

5B12N

Display Mode	B
B SOURCE	LEFT
B TRIGGERING	+ SLOPE
B SECONDS/DIV	.2 m

Apply 0.1 ms markers from the Time-Mark Generator and adjust B LEVEL for a stable display. Adjust R438 (B TIMING 1) for exactly 2 time-markers/div.

8. B Sweep Length

Set B SECONDS/DIV to 1 m and apply 1 ms markers from the Time-Mark Generator. Position the second time-mark to the first graticule line and check that the sweep ends within the last graticule division.

9. B SECONDS/DIV Accuracy

Set B SECONDS/DIV to 5 μ and apply 5 μs markers from the Time-Mark Generator. Adjust C429 (B TIMING 2) for exactly 1 time-mark/div. Apply markers from the Time-Mark Generator as specified in Table 3-2. Adjust B LEVEL for a stable display. Check sweep accuracy over the middle 8 graticule divisions as described in Table 3-2.

TABLE 3-2

SECONDS/DIV switch setting	Time marker selector	CRT display (Markers/ division)	Accuracy (measured between first and ninth graticule lines)
.2 μ	.1 μs	2	±4% (0.32 div)
.5 μ	.5 μs	1	±3% (0.24 div)
1 μ	1 μs	1	
2 μ	1 μs	2	
5 μ	5 μs	1	
10 μ	10 μs	1	
20 μ	10 μs	2	
50 μ	50 μs	1	
.1 m	.1 ms	1	
.2 m	.1 ms	2	
.5 m	.5 ms	1	
1 m	1 ms	1	
2 m	1 ms	2	
5 m	5 ms	1	
10 m	10 ms	1	
20 m	10 ms	2	
50 m	50 ms	1	
.1	.1 s	1	
.2	.1 s	2	±4% (0.32 div)
.5	.5 s	1	

10. Delay Stop and Start (R204/R208)

Change the following control settings:

5B12N

A SECONDS/DIV	1 m
B SECONDS/DIV	50 μ
Display Mode	DUAL SWEEP (both A & B pushed in) and A INTEN B DLY'D
DELAY TIME MULT	1.0

Amplifier (5A15N)

Volts/Div	1

Adjust R208 (DELAY START) so that the intensified portion of the trace begins on the second time-mark (note upper display). Set the DELAY TIME MULT to 10.0 and adjust R204 (DELAY STOP) so that intensified portion of the trace begins on the last time-mark. Repeat these adjustments as necessary. Set the intensified portion of the trace to begin on the second time-mark; the dial should read 1.0. Set the intensified portion of the trace to begin on each of the time-marks and check that the DELAY TIME MULT dial reading corresponds to the number of the intensified time-mark. Set 5B12N DISPLAY MODE to B TRIG AFTER DLY and B SOURCE to LEFT. Apply 1 ms markers and adjust A & B LEVEL for two stable displays. Turn DELAY TIME MULT and check that the intensified portion of the trace jumps from one time-mark to the next. Release B TRIG AFTER DLY button.

11. Delay Time Accuracy

Set A SECONDS/DIV to 10 m and B SECONDS/DIV to .1 m. Apply 1 ms markers and position the first time-mark to the first graticule line. Adjust DELAY TIME MULT so that the trace begins on the time-mark coincident with the tenth (last) graticule line; dial should read 10.0 ±5 minor dial divisions. Repeat this procedure as described in Table 3-3.

TABLE 3-3

A SECONDS/DIV switch setting	B SECONDS/DIV switch setting	Time marker selector
5 m	50 μ	5 ms
2 m	20 μ	1 ms
1 m	10 μ	1 ms
.5 m	5 μ	.5 ms
.2 m	2 μ	.1 ms
.1 m	1 μ	.1 ms
50 μ	.5 μ	50 μs

Set A SECONDS/DIV to 1 m and B SECONDS/DIV to 1 μ. Apply 1 ms markers and adjust DELAY TIME MULT to display the next to the last time-mark on the upper trace. Check for 0.5 div or less of jitter.

Set A SECONDS/DIV to 1 and B SECONDS/DIV to .1. Set DELAY TIME MULT to 9.5 and apply 1 s markers. Turn the trace intensity up to position the sweep start on the first graticule line. Check that a time mark falls between the fourth and sixth graticule lines. Return intensity to normal.

12. B Sweep Triggering

Change the following control settings:

5B12N

B SECONDS/DIV	1 μ
Display Mode	B
Sweep Mode	AUTO TRIG
B TRIGGERING	– SLOPE
B COUPLING	DC

Amplifier (5A15N)

Volts/Div	50 mV

Connect the Sine-Wave Generator to the Coaxial Cable and Termination, to the Amplifier plug-in installed in the left compartment. Adjust the Generator for a 2 MHz, 0.6 div output. Adjust B LEVEL for a stable display and B SECONDS/DIV to 10 μ. Adjust the Generator for a 50 kHz, 6 div output and check that the waveform is triggered on the –slope (down).

Move the Generator signal setup to the + Input of the Amplifier plug-in installed in the center compartment. Change the following control settings:

5B12N

B SOURCE	RIGHT
B COUPLING	AC
B TRIGGERING	+ SLOPE

Amplifier (5A21N)

Display	On
Volts/Div	50 mV

Amplifier (5A15N)

Display	Off

Check that the waveform is triggered on the + slope (up). Change the following control settings:

5B12N

B COUPLING	DC
B SOURCE	LINE

Amplifier (5A21N)

Volts/Div	10 mV

Disconnect the Sine-Wave Generator. Turn B LEVEL fully ccw then fully cw and check that the trace brightens at each extreme.

13. A Sweep Triggering

Connect the Sine-Wave Generator to the Amplifier plug-in installed in the left compartment and to 5B12N A EXT INPUT through the Dual Input Cable.

Change the following control settings:

5B12N

Display Mode	A & B
A COUPLING	AC
A SOURCE	EXT
A SECONDS/DIV	1 μ

Amplifier (5A15N)

Display	On

Amplifier (5A21N)

Display	Off

Adjust the Sine-Wave Generator for a 2 MHz, 4 div output. Adjust A LEVEL for a stable display. Set A SECONDS/DIV to 10 m. Adjust the Generator for a 50 Hz, 4 div output and change the following control settings:

5B12N

Sweep Mode	AUTO TRIG
A COUPLING	DC
A TRIGGERING	– SLOPE
A SECONDS/DIV	50 m

Adjust the Generator for a 15 Hz output and adjust A LEVEL for a stable display. Check that the waveform is triggered on the – slope. Set A TRIGGERING to + SLOPE and check that the waveform is triggered on the + slope.

Set the Sine-Wave Generator for a 1 kHz, 10 V output. Change the following control settings:

5B12N

A SECONDS/DIV	.5 m

Amplifier (5A15N)

Volts/Div	5

Turn A LEVEL fully cw then fully ccw and check that the display does not trigger at either extreme.

14. Single Sweep

Apply 0.5 s time-markers from Time-Mark Generator to the + input of the Amplifier plug-in installed in the center compartment. Change the following control settings:

5B12N	
A SECONDS/DIV	5 m
Sweep Mode	A SINGL SWP

Disconnect the time-markers and press A RESET. Check that READY light is lit. Reconnect the time-markers and check that the trace sweeps once and that the READY light goes out.

15. Alternate/Chopped

Remove all cables and change the following control settings:

5B12N	
A SINGL SWP	Out
A SECONDS/DIV	10 m
A SOURCE	LEFT & RIGHT

Amplifier (5A15N)	
Display	On

Check for an alternating display. Change the following control settings:

5B12N	
A SECONDS/DIV	50 μ
DISPLAY	CHOP
B SECONDS/DIV	5 μ

Check for a chopped display. Release the Display button on the Amplifier plug-in installed in the center compartment and again check for a chopped display.

16. Line Trigger

Change the following control settings:

5B12N	
Display Mode	A
DISPLAY	CHOP
A SECONDS/DIV	.1 m

Press A SOURCE LINE and check that the trace dims.

17. INTENsity BALance

Change the following control settings:

5B12N	
A SOURCE	LEFT
Display Mode	A & B
A SECONDS/DIV	.1 m
B SECONDS/DIV	.1 m

Adjust the intensity for a normal display. Turn INTEN BAL fully cw and check that one trace dims. Turn INTEN BAL fully ccw and check that the other trace dims.

18. External Horizontal

Remove the Amplifier plug-in installed in the left compartment. Install a Time Base/Amplifier (5B10N) plug-in in the left compartment.

Change the following control settings:

5B12N	
A SECONDS/DIV (A VOLTS/DIV)	.5 V

Time Base (5B10N)	
Seconds/Div	.2 m
Triggering	AUTO TRIG
Level	Centered
Source	EXT
Variable	Calibrated (fully cw)

Amplifier (5A21N)	
Display	Off
All other buttons	Out

Connect the Standard Amplitude Calibrator to both external inputs and set for a 2 V output. Check for 4 div ± 0.12. Adjust C104 (ATT) for a square corner.

Set 5B12N A SECONDS/DIV to 50 m and turn CAL fully ccw. Check for less than 5 div of display. Return CAL to fully cw (calibrated) position. Set the Standard Amplitude Calibrator for a 0.2 V output. Again check for 4 div ± 0.12.

This completes the 5B12N calibration procedure.

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μF).

Resistors = Ohms (Ω).

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

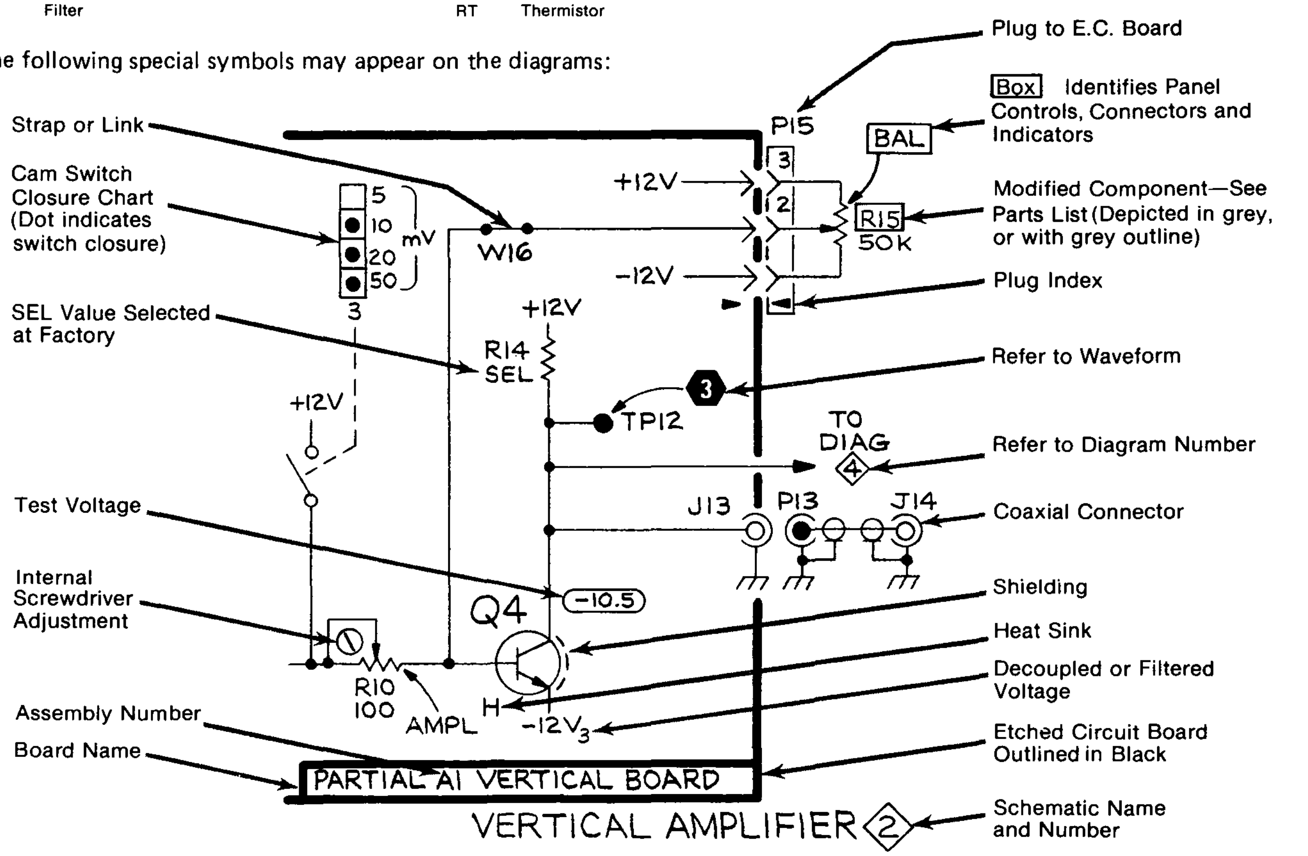
Abbreviations are based on ANSI Y1.1-1972.
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

Y14.15, 1966	Drafting Practices.
Y14.2, 1973	Line Conventions and Lettering.
Y10.5, 1968	Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc)	H	Heat dissipating device (heat sink, heat radiator, etc)	S	Switch or contactor
AT	Attenuator, fixed or variable	HR	Heater	T	Transformer
B	Motor	HY	Hybrid circuit	TC	Thermocouple
BT	Battery	J	Connector, stationary portion	TP	Test point
C	Capacitor, fixed or variable	K	Relay	U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
CB	Circuit breaker	L	Inductor, fixed or variable	V	Electron tube
CR	Diode, signal or rectifier	M	Meter	VR	Voltage regulator (zener diode, etc.)
DL	Delay line	P	Connector, movable portion	W	Wirestrap or cable
DS	Indicating device (lamp)	Q	Transistor or silicon-controlled rectifier	Y	Crystal
E	Spark Gap, Ferrite bead	R	Resistor, fixed or variable	Z	Phase shifter
F	Fuse	RT	Thermistor		
FL	Filter				

The following special symbols may appear on the diagrams:



REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

ACTR	ACTUATOR
ASSY	ASSEMBLY
CAP	CAPACITOR
CER	CERAMIC
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
ELCTLT	ELECTROLYTIC
ELEC	ELECTRICAL
INCAND	INCANDESCENT
LED	LIGHT EMITTING DIODE
NONWIR	NON WIREWOUND
PLSTC	PLASTIC
QTZ	QUARTZ
RECP	RECEPTACLE
RES	RESISTOR
RF	RADIO FREQUENCY
SEL	SELECTED
SEMICOND	SEMICONDUCTOR
SENS	SENSITIVE
VAR	VARIABLE
WW	WIREWOUND
XFMR	TRANSFORMER
XTAL	CRYSTAL

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
00853	SANGAMO WESTON INC SANGAMO CAPACITOR DIV	SANGAMO RD P O BOX 128	PICKENS SC 29671
01121	ALLEN-BRADLEY CO	1201 SOUTH 2ND ST	MILWAUKEE WI 53204
02111	SPECTROL ELECTRONICS CORP SUB OF CARRIER CORP	17070 E GALE AVE P O BOX 1220	CITY OF INDUSTRY CA 91749
03508	GENERAL ELECTRIC CO SEMI-CONDUCTOR PRODUCTS DEPT	W GENESEE ST	AUBURN NY 13021
04222	AVX CERAMICS DIV OF AVX CORP	19TH AVE SOUTH P O BOX 867	MYRTLE BEACH SC 29577
04713	MOTOROLA INC SEMICONDUCTOR GROUP	5005 E MCDOWELL RD	PHOENIX AZ 85008
05397	UNION CARBIDE CORP MATERIALS SYSTEMS DIV	11901 MADISON AVE	CLEVELAND OH 44101
07263	FAIRCHILD CAMERA AND INSTRUMENT CORP SEMICONDUCTOR DIV	464 ELLIS ST	MOUNTAIN VIEW CA 94042
07716	TRW INC TRW ELECTRONICS COMPONENTS TRW IRC FIXED RESISTORS/BURLINGTON	2850 MT PLEASANT AVE	BURLINGTON IA 52601
07910	TELEDYNE SEMICONDUCTOR		HAWTHORNE CA
08806	GENERAL ELECTRIC CO MINIATURE LAMP PRODUCTS DEPT	NELA PK	CLEVELAND OH 44112
12697	CLAROSTAT MFG CO INC	LOWER WASHINGTON ST	DOVER NH 03820
13511	AMPHENOL CADRE DIV BUNKER RAMO CORP		LOS GATOS CA
14433	ITT SEMICONDUCTORS DIV		WEST PALM BEACH FL
14552	MICRO/SEMICONDUCTOR CORP	2830 S FAIRVIEW ST	SANTA ANA CA 92704
15238	ITT SEMICONDUCTORS A DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORP	500 BROADWAY P O BOX 168	LAWRENCE MA 01841
19701	MEPCO/ELECTRA INC A NORTH AMERICAN PHILIPS CO	P O BOX 760	MINERAL WELLS TX 76067
21847	TRW MICROWAVE INC SUB OF TRW INC	825 STEWART DR	SUNNYVALE CA 94086
31433	UNION CARBIDE CORP ELECTRONICS DIV	PO BOX 5928	GREENVILLE SC 29606
31918	ITT SCHADOW INC	8081 WALLACE RD	EDEN PRAIRIE MN 55343
32997	BOURNS INC TRIMPOT DIV	1200 COLUMBIA AVE	RIVERSIDE CA 92507
52763	STETTNER ELECTRONICS INC	6135 AIRWAYS BLVD PO BOX 21947	CHATTANOOGA TN 37421
53944	GLOW LITE CORP	BOX 698	PAULS VALLEY OK 73075
57668	ROHM CORP	16931 MILLIKEN AVE	IRVINE CA 92713
59660	TUSONIX INC	2155 N FORBES BLVD	TUCSON, ARIZONA 85705
59821	CENTRALAB INC SUB NORTH AMERICAN PHILIPS CORP	7158 MERCHANT AVE	EL PASO TX 79915
74970	JOHNSON E F CO	299 10TH AVE S W	WASECA MN 56093
80009	TEKTRONIX INC	4900 S W GRIFFITH DR P O BOX 500	BEAVERTON OR 97077
S3774	OSHINO ELECTRIC LAMP WORKS LTD	5 2 MINAMI SHINAGAWA 2 CHORE SHINAGAWA KU	TOKYO, JAPAN
TK0965	WAMCO TECHNICAL SALES INC (DIST)	705 W 16TH ST	COSTA MESA CA 92627

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A1	670-1346-00	B010100	B019999	CIRCUIT BD ASSY:MAIN	80009	670-1346-00
A1	670-1346-01	B020000	B069999	CIRCUIT BD ASSY:MAIN	80009	670-1346-01
A1	670-1346-02	B070000	B079845	CIRCUIT BD ASSY:MAIN	80009	670-1346-02
A1	670-1346-03	B079846	B080497	CIRCUIT BD ASSY:MAIN	80009	670-1346-03
A1	670-1346-04	B080498		CIRCUIT BD ASSY:MAIN	80009	670-1346-04
A2	670-1561-00			CIRCUIT BD ASSY:AUXILLARY NO.1	80009	670-1561-00
A3	670-1560-00			CIRCUIT BD ASSY:AUXILLARY NO.2	80009	670-1560-00
C102	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG
C103	281-0512-00			CAP,FXD,CER DI:27PF,+/-2.7PF,500V	52763	2RDPLZ007 27POKC
C104	281-0078-00			CAP,VAR,AIR DI:1.4-9.2PF,750V	74970	189-0503-075
C105	283-0598-00			CAP,FXD,MICA DI:253PF,5%,300V	00853	D155F2530J0
C111	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG
C112	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG
C113	281-0518-00			CAP,FXD,CER DI:47PF,+/-9.4PF,500V	52763	2RDPLZ007 47POMU
C114	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG
C121	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG
C134	281-0600-00			CAP,FXD,CER DI:35PF,10%,500V	52763	2RDPLZ007 35POKC
C135	281-0546-00	B050000		CAP,FXD,CER DI:330PF,10%,500V	52763	2RDPLZ007 330PMO
C136	281-0524-00	B010100	B049999	CAP,FXD,CER DI:150PF,+/-30PF,500V	52763	2RDPLZ007 150PMO
C137	281-0562-00	B010100	B049999	CAP,FXD,CER DI:39PF,10%,500V	52763	2RDPLZ007 39POKU
C137	281-0523-00	B050000	B059999	CAP,FXD,CER DI:100PF,20%,350V	52763	2RDPLZ007 100PMU
C137	283-0060-00	B060000		CAP,FXD,CER DI:100PF,5%,200V	59660	855-535U2J101J
C151	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG
C154	281-0546-00			CAP,FXD,CER DI:330PF,10%,500V	52763	2RDPLZ007 330PMO
C155	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG
C156	290-0267-00			CAP,FXD,ELCTLT:1UF,20%,35V	05397	T320A105M035AS
C161	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG
C162	281-0524-00			CAP,FXD,CER DI:150PF,+/-30PF,500V	52763	2RDPLZ007 150PMO
C164	283-0051-00			CAP,FXD,CER DI:0.0033UF,5%,100V	04222	SR301A332JAA
C167	281-0546-00			CAP,FXD,CER DI:330PF,10%,500V	52763	2RDPLZ007 330PMO
C176	290-0134-00			CAP,FXD,ELCTLT:22UF,20%,15V	05397	T110B226M015AS
C179	290-0247-00			CAP,FXD,ELCTLT:5.6UF,10%,6V	05397	T322B565K006AS
C206	290-0267-00			CAP,FXD,ELCTLT:1UF,20%,35V	05397	T320A105M035AS
C210	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG
C216	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG
C218	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG
C221	281-0518-00			CAP,FXD,CER DI:47PF,+/-9.4PF,500V	52763	2RDPLZ007 47POMU
C222	281-0523-00			CAP,FXD,CER DI:100PF,20%,350V	52763	2RDPLZ007 100PMU
C224	295-0151-00			CAP SET,MATCHED:10UF,1UF,0.1UF,0.01UF,	80009	295-0151-00
C225	----- -----			(PART OF C224)		
C229	----- -----			(PART OF C224)		
C246	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG
C270	281-0572-00			CAP,FXD,CER DI:6.8PF,0.5%,500V	52763	2RDPLZ007 6P80DC
C275	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG
C311	283-0000-00			CAP,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-610-Y5U0102P
C314	283-0026-00			CAP,FXD,CER DI:0.2UF,+80-20%,25V	31433	C330C332JIG5CA
C354	281-0523-00			CAP,FXD,CER DI:100PF,20%,350V	52763	2RDPLZ007 100PMU
C355	283-0000-00			CAP,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-610-Y5U0102P
C356	290-0188-00			CAP,FXD,ELCTLT:0.1UF,10%,35V	05397	T322A104K035AS
C365	283-0051-00			CAP,FXD,CER DI:0.0033UF,5%,100V	04222	SR301A332JAA
C367	281-0543-00			CAP,FXD,CER DI:270PF,10%,500V	52763	2RDPLZ007 27POMO
C376	290-0134-00			CAP,FXD,ELCTLT:22UF,20%,15V	05397	T110B226M015AS
C379	290-0247-00			CAP,FXD,ELCTLT:5.6UF,10%,6V	05397	T322B565K006AS
C409	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG
C416	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG
C418	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG

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C421	281-0518-00	B010100	B039999	CAP,FXD,CER DI:47PF,+/-9.4PF,500V	52763	2RDPLZ007 47POMU
C422	281-0523-00	B010100	B039999	CAP,FXD,CER DI:100PF,20%,350V	52763	2RDPLZ007 100PMU
C422	283-0000-00	B040000		CAP,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-610-Y5U0102P
C424	----- -----			(PART OF C224)		
C425	----- -----			(PART OF C224)		
C427	283-0631-00	B010100	B049999	CAP,FXD,MICA DI:95PF,1%,500V	00853	D155F950F0
C427	283-0706-00	B050000		CAP,FXD,MICA DI:91PF,1%,500V	00853	D155F910F0
C429	281-0079-00	B010100	B049999	CAP,VAR,AIR DI:1.5-9.1PF,375V	74970	189-0504-075
C429	281-0166-00	B050000		CAP,VAR,AIR DI:1.9-15.7 PF,250V	74970	187-0109-055
C446	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG
C454	281-0523-00	B060000		CAP,FXD,CER DI:100PF,20%,350V	52763	2RDPLZ007 100PMU
C470	283-0026-00			CAP,FXD,CER DI:0.2UF,+80-20%,25V	31433	C330C332JIG5CA
C471	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG
C475	281-0546-00			CAP,FXD,CER DI:330PF,10%,500V	52763	2RDPLZ007 330PMO
C478	281-0546-00			CAP,FXD,CER DI:330PF,10%,500V	52763	2RDPLZ007 330PMO
C490	283-0002-00			CAP,FXD,CER DI:0.01UF,+80-20%,500V	59821	D103Z40Z5ULADEG
C493	283-0000-00			CAP,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-610-Y5U0102P
C497	281-0512-00			CAP,FXD,CER DI:27PF,+/-2.7PF,500V	52763	2RDPLZ007 27POKC
CR124	152-0246-00			SEMICOND DVC,DI:SW,SI,40V,200MA,DO-7	14433	WG1537TK
CR126	152-0246-00			SEMICOND DVC,DI:SW,SI,40V,200MA,DO-7	14433	WG1537TK
CR131	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR133	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR139	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR162	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR166	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR167	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR259	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR260	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR261	152-0141-02	B010100	B049999	SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR263	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR270	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR318	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR327	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR363	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR365	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR367	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR418	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR450	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR459	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR472	152-0185-00	B010100	B062977	SEMICOND DVC,DI:SW,SI,30V,0.15A,DO-35	07910	1N4152
CR472	152-0008-00	B062978	B079966	SEMICOND DVC,DI:SIG,GE,60V,60MA,A38A	14433	G1409
CR472	152-0725-00	B079967		SEMICOND DVC,DI:SI,SCHOTTKY,20V,1.2PF,DO-35	21847	A2X1582
CR475	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR478	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR480	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR485	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR490	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR491	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR492	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR498	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
CR499	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V,DO-35	03508	DA2527 (1N4152)
DS248	150-0111-00	B010100	B069999	LAMP,GLOW:125V MAX,1.5MA,2AC-AT,WIRE	53944	A1B-9
DS248	150-0075-00	B070000		LAMP,INCAND:10V,0.013A,#21490,WIRE LD	TK0965	OL 1869TPL
DS249	150-0111-00	B010100	B069999	LAMP,GLOW:125V MAX,1.5MA,2AC-AT,WIRE	53944	A1B-9
DS249	150-0075-00	B070000		LAMP,INCAND:10V,0.013A,#21490,WIRE LD	TK0965	OL 1869TPL
DS250	150-0111-00	B010100	B069999	LAMP,GLOW:125V MAX,1.5MA,2AC-AT,WIRE	53944	A1B-9
DS250	150-0075-00	B070000		LAMP,INCAND:10V,0.013A,#21490,WIRE LD	TK0965	OL 1869TPL
DS270	150-0099-00	B010100	B049999	LAMP,INCAND:5V,0.015A,#2208,WIRE LEADS	08806	2208

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DS270	150-0046-00	B050000		LAMP,INCAND:10V,0.04A,#2107D,WIRE LEAD	S3774	OL-2107-TPL
J101	131-0955-00			CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
Q128	151-1049-00			TRANSISTOR:FET,N-CHAN,SI,TO-71	04713	SFD1049
Q132	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q133	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q144	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q214	151-0254-00			TRANSISTOR:DARLINGTON,NPN,SI	03508	X38L3118
Q246	151-0224-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS6917
Q260	151-1025-00	B010100	B064283	TRANSISTOR:FET,N-CHAN,SI,TO-92	04713	SPF3036
Q260	151-1006-00	B064284		TRANSISTOR:FET,N-CHAN,SI,TO-106	04713	SPF3035
Q270	151-0219-00			TRANSISTOR:PNP,SI,R-124	07263	S022650
Q315	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q320	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q446	151-0224-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS6917
Q450	151-1025-00	B010100	B064283	TRANSISTOR:FET,N-CHAN,SI,TO-92	04713	SPF3036
Q450	151-1006-00	B064284		TRANSISTOR:FET,N-CHAN,SI,TO-106	04713	SPF3035
Q455	151-1025-00	B010100	B064283	TRANSISTOR:FET,N-CHAN,SI,TO-92	04713	SPF3036
Q455	151-1006-00	B064284		TRANSISTOR:FET,N-CHAN,SI,TO-106	04713	SPF3035
Q465	151-1025-00	B010100	B064283	TRANSISTOR:FET,N-CHAN,SI,TO-92	04713	SPF3036
Q465	151-1006-00	B064284		TRANSISTOR:FET,N-CHAN,SI,TO-106	04713	SPF3035
Q480	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q485	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q490	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
Q495	151-0341-00			TRANSISTOR:NPN,SI,TO-106	04713	SPS6919
R101	316-0102-00	B010100	B078820	RES,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R101	315-0102-00	B078821		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R103	322-0621-01			RES,FXD,FILM:900K OHM,0.5%,0.25W,TC=T0	57668	CRB60 DXE 900K
R105	321-0645-00			RES,FXD,FILM:100K OHM,0.5%,0.125W,TC=T2	19701	5033RC1003D
R112	316-0224-00	B010100	B078820	RES,FXD,CMPSN:220K OHM,10%,0.25W	01121	CB2241
R112	315-0224-00	B078821		RES,FXD,FILM:220K OHM,5%,0.25W	57668	NTR25J-E220K
R113	316-0222-00			RES,FXD,CMPSN:2.2K OHM,10%,0.25W	01121	CB2221
R114	316-0105-00	B010100	B078820	RES,FXD,CMPSN:1M OHM,10%,0.25W	01121	CB1051
R114	315-0105-00	B078821		RES,FXD,FILM:1M OHM,5%,0.25W	19701	5043CX1M000J
R121	316-0105-00	B010100	B078820	RES,FXD,CMPSN:1M OHM,10%,0.25W	01121	CB1051
R121	315-0105-00	B078821		RES,FXD,FILM:1M OHM,5%,0.25W	19701	5043CX1M000J
R122	316-0222-00	B010100	B080425	RES,FXD,CMPSN:2.2K OHM,10%,0.25W	01121	CB2221
R122	315-0222-00	B080426		RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
R128	315-0303-00			RES,FXD,FILM:30K OHM,5%,0.25W	19701	5043CX30K00J
R129	315-0303-00			RES,FXD,FILM:30K OHM,5%,0.25W	19701	5043CX30K00J
R130	316-0153-00	B010100	B078820	RES,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R130	315-0153-00	B078821		RES,FXD,FILM:15K OHM,5%,0.25W	19701	5043CX15K00J
R131	315-0362-00			RES,FXD,FILM:3.6K OHM,5%,0.25W	19701	5043CX3K600J
R133	315-0303-00			RES,FXD,FILM:30K OHM,5%,0.25W	19701	5043CX30K00J
R134	316-0471-00	B010100	B078820	RES,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
R134	315-0471-00	B078821		RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
R135	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R136	316-0274-00	B010100	B078820	RES,FXD,CMPSN:270K OHM,10%,0.25W	01121	CB2741
R136	315-0274-00	B078821		RES,FXD,FILM:270K OHM,5%,0.25W	57668	NTR25J-E270K
R137	315-0303-00			RES,FXD,FILM:30K OHM,5%,0.25W	19701	5043CX30K00J
R139	316-0391-00	B010100	B078820	RES,FXD,CMPSN:390 OHM,10%,0.25W	01121	CB3911
R139	315-0391-00	B078821		RES,FXD,FILM:390 OHM,5%,0.25W	57668	NTR25J-E390E
R142	321-0158-00			RES,FXD,FILM:432 OHM,1%,0.125W,TC=T0	07716	CEAD432R0F
R143	316-0153-00	B010100	B078820	RES,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R143	315-0153-00	B078821		RES,FXD,FILM:15K OHM,5%,0.25W	19701	5043CX15K00J
R144	315-0303-00			RES,FXD,FILM:30K OHM,5%,0.25W	19701	5043CX30K00J
R145	321-0160-00			RES,FXD,FILM:453 OHM,1%,0.125W,TC=T0	19701	5033ED453R0F
R150	311-0678-00			RES,VAR,NONWW:PNL,2X50K OHM,0.5W,CMPSN OR CERMET	12697	381-CM39681

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R151	316-0103-00	B010100	B078820	RES,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R151	315-0103-00	B078821		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R152	316-0105-00	B010100	B078820	RES,FXD,CMPSN:1M OHM,10%,0.25W	01121	CB1051
R152	315-0105-00	B078821		RES,FXD,FILM:1M OHM,5%,0.25W	19701	5043CX1M000J
R155	316-0223-00	B010100	B078820	RES,FXD,CMPSN:22K OHM,10%,0.25W	01121	CB2231
R155	315-0223-00	B078821		RES,FXD,FILM:22K OHM,5%,0.25W	19701	5043CX22K00J92U
R161	316-0106-00	B010100	B078820	RES,FXD,CMPSN:10M OHM,10%,0.25W	01121	CB1061
R161	315-0106-00	B078821		RES,FXD,FILM:10M OHM,5%,0.25W	01121	CB1065
R163	316-0472-00	B010100	B078820	RES,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R163	315-0472-00	B078821		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R164	316-0122-00	B010100	B078820	RES,FXD,CMPSN:1.2K OHM,10%.0.25W	01121	CB1221
R164	315-0122-00	B078821		RES,FXD,FILM:1.2K OHM,5%,0.25W	57668	NTR25J-E01K2
R165	315-0332-00			RES,FXD,FILM:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
R166	316-0103-00	B010100	B078820	RES,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R166	315-0103-00	B078821		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R167	316-0103-00	B010100	B078820	RES,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R167	315-0103-00	B078821		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R169	316-0270-00	B010100	B064885	RES,FXD,CMPSN:27 OHM,10%,0.25W	01121	CB2701
R169	315-0201-00	B064886		RES,FXD,FILM:200 OHM,5%,0.25W	57668	NTR25J-E200E
R171	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R172	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R173	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R176	307-0113-00			RES,FXD,CMPSN:5.1 OHM,5%,0.25W	01121	CB51G5
R179	316-0223-00	B010100	B078820	RES,FXD,CMPSN:22K OHM,10%,0.25W	01121	CB2231
R179	315-0223-00	B078821		RES,FXD,FILM:22K OHM,5%,0.25W	19701	5043CX22K00J92U
R201	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R202	321-0780-03			RES,FXD,FILM:18.96K OHM,0.25%,0.125W,TC=T2	07716	CEA18.96KOHM 25%
R203	316-0472-00	B010100	B078820	RES,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R203	315-0472-00	B078821		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R204	311-0633-00			RES,VAR,NONWW:TRMR,5K OHM,0.5W	32997	3329H-G48-502
R205	311-0838-00			RES,VAR,WW:PNL,10K OHM,1W	02111	162-179
R206	316-0103-00	B010100	B078820	RES,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R206	315-0103-00	B078821		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R207	321-0829-02			RES,FXD,FILM:202 OHM,0.5%,0.125W,TC=T2	19701	5033RC202R0D
R208	311-0613-00			RES,VAR,NONWW:TRMR,100K OHM,0.5W	32997	3329H-G48-104
R209	321-0356-00	B010100	B019999	RES,FXD,FILM:49.9K OHM,1%,0.125W,TC=T0	19701	5033ED49K90F
R209	321-0332-00	B020000		RES,FXD,FILM:28.0K OHM,1%,0.125W,TC=T0	07716	CEAD28001F
R210	316-0104-00	B010100	B078820	RES,FXD,CMPSN:100K OHM,10%,0.25W	01121	CB1041
R210	315-0104-00	B078821		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
R211	321-0397-00			RES,FXD,FILM:133K OHM,1%,0.125W,TC=T0	19701	5043ED133K0F
R212	321-0406-00			RES,FXD,FILM:165K OHM,1%,0.125W,TC=T0	07716	CEAD16502F
R214	316-0221-00	B010100	B078820	RES,FXD,CMPSN:220 OHM,10%,0.25W	01121	CB2211
R214	315-0221-00	B078821		RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
R218	301-0182-00			RES,FXD,FILM:1.8K OHM,5%,0.5W	19701	5053CX1K800J
R219	311-0613-00			RES,VAR,NONWW:TRMR,100K OHM,0.5W	32997	3329H-G48-104
R222	316-0101-00	B010100	B078820	RES,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R222	315-0101-00	B078821		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R223	316-0274-00	B010100	B078820	RES,FXD,CMPSN:270K OHM,10%,0.25W	01121	CB2741
R223	315-0274-00	B078821		RES,FXD,FILM:270K OHM,5%,0.25W	57668	NTR25J-E270K
R224	315-0330-00	B065803		RES,FXD,FILM:33 OHM,5%,0.25W	19701	5043CX33R00J
R225	323-0498-03			RES,FXD,FILM:1.5MEG OHM,0.25%,0.5W,TC=T9	19701	5053RC1M500C
R226	323-0498-03			RES,FXD,FILM:1.5MEG OHM,0.25%,0.5W,TC=T9	19701	5053RC1M500C
R227	321-0917-03			RES,FXD,FILM:2792K OHM,0.25%,0.125W,TC=T2	19701	5033RD27K20C
R229	321-0856-03			RES,FXD,FILM:330K OHM,0.25%,0.125W,TC=T2	19701	5033C330K0C
R231	321-0200-00			RES,FXD,FILM:1.18K OHM,1%,0.125W,TC=T0	19701	5033ED11K80F
R232	321-0830-03			RES,FXD,FILM:2.41K OHM,0.25%,0.125W,TC=T2	07716	CEAC24100C
R233	321-0827-03			RES,FXD,FILM:3.61K OHM,0.25%,0.125W,TC=T2	19701	5033RC3K610C
R234	321-0268-03			RES,FXD,FILM:6.04K OHM,0.25%,0.125W,T=T2	07716	CEAC60400C

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
R235	311-1128-00			RES,VAR,NONWW:PNL,20K X 5K OHM,0.5W	12697	CM40069
R236	321-0234-00			RES,FXD,FILM:2.67K OHM,1%,0.125W,TC=T0	19701	5033ED2K67F
R237	316-0124-00	B010100	B078820	RES,FXD,CMPSN:120K OHM,10%,0.25W	01121	CB1241
R237	315-0124-00	B078821		RES,FXD,FILM:120K OHM,5%,0.25W	19701	5043CX120K0J
R238	321-0164-00			RES,FXD,FILM:499 OHM,1%,0.125W,TC=T0	19701	5033ED499R0F
R240	311-0634-00			RES,VAR,NONWW:TRMR,500 OHM,0.5W	32997	3329H-L58-501
R241	321-0258-00			RES,FXD,FILM:4.75K OHM,1%,0.125W,TC=T0	19701	5033ED4K750F
R243	321-0916-03			RES,FXD,FILM:289 OHM,0.25%,0.125W,TC=T2	19701	5033RC289R0C
R244	321-1263-02	B010100	B019999	RES,FXD,FILM:5.42K OHM,0.5%,0.125W,TC=T2	19701	5033RC5K420D
R244	321-0951-02	B020000		RES,FXD,FILM:5.52K OHM,0.5%,0.125W,TC=T2	57668	RB14DYE 5K52
R245	311-0678-00			RES,VAR,NONWW:PNL,2X50K OHM,0.5W,CMPSN OR CERMET	12697	381-CM39681
R246	315-0133-00			RES,FXD,FILM:13K OHM,5%,0.25W	19701	5043CX13K00J
R248	316-0124-00	B010100	B069999	RES,FXD,CMPSN:120K OHM,10%,0.25W	01121	CB1241
R248	315-0821-00	B070000		RES,FXD,FILM:820 OHM,5%,0.25W	19701	5043CX820R0J
R250	316-0124-00	B010100	B069999	RES,FXD,CMPSN:120K OHM,10%,0.25W	01121	CB1241
R259	315-0303-00			RES,FXD,FILM:30K OHM,5%,0.25W	19701	5043CX30K00J
R260	316-0103-00	B010100	B078820	RES,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R260	315-0103-00	B078821		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R270	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R272	321-0320-00			RES,FXD,FILM:21.0K OHM,1%,0.125W,TC=T0	19701	5033ED21K00F
R275	321-0285-00			RES,FXD,FILM:9.09K OHM,1%,0.125W,TC=T0	07716	CEAD90900F
R312	316-0473-00	B010100	B080425	RES,FXD,CMPSN:47K OHM,10%,0.25W	01121	CB4731
R312	315-0473-00	B080426		RES,FXD,FILM:47K OHM,5%,0.25W	57668	NTR25J-E47K0
R314	316-0473-00	B010100	B078820	RES,FXD,CMPSN:47K OHM,10%,0.25W	01121	CB4731
R314	315-0473-00	B078821		RES,FXD,FILM:47K OHM,5%,0.25W	57668	NTR25J-E47K0
R315	316-0102-00	B010100	B078820	RES,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R315	315-0102-00	B078821		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R317	316-0391-00	B010100	B029999	RES,FXD,CMPSN:390 OHM,10%,0.25W	01121	CB3911
R317	315-0101-00	B030000		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R318	316-0123-00	B010100	B078820	RES,FXD,CMPSN:12K OHM,10%,0.25W	01121	CB1231
R318	315-0123-00	B078821		RES,FXD,FILM:12K OHM,5%,0.25W	57668	NTR25J-E12K0
R321	315-0332-00	B010100	B019999	RES,FXD,FILM:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
R321	315-0362-00	B020000	B029999	RES,FXD,FILM:3.6K OHM,5%,0.25W	19701	5043CX3K600J
R321	315-0332-00	B030000		RES,FXD,FILM:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
R324	315-0133-00	B010100	B029999	RES,FXD,FILM:13K OHM,5%,0.25W	19701	5043CX13K00J
R324	315-0163-00	B030000		RES,FXD,FILM:16K OHM,5%,0.25W	57668	NTR25J-E 16K
R325	316-0333-00	B010100	B019999	RES,FXD,CMPSN:33K OHM,10%,0.25W	01121	CB3331
R325	315-0273-00	B020000		RES,FXD,FILM:27K OHM,5%,0.25W	57668	NTR25J-E27K0
R327	316-0472-00	B010100	B029999	RES,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R327	315-0912-00	B030000		RES,FXD,FILM:9.1K OHM,5%,0.25W	57668	NTR25J-E09K1
R328	316-0473-00			RES,FXD,CMPSN:47K OHM,10%,0.25W	01121	CB4731
R351	316-0103-00	B010100	B078820	RES,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R351	315-0103-00	B078821		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R352	316-0105-00	B010100	B078820	RES,FXD,CMPSN:1M OHM,10%,0.25W	01121	CB1051
R352	315-0105-00	B078821		RES,FXD,FILM:1M OHM,5%,0.25W	19701	5043CX1M000J
R355	316-0223-00	B010100	B078820	RES,FXD,CMPSN:22K OHM,10%,0.25W	01121	CB2231
R355	315-0223-00	B078821		RES,FXD,FILM:22K OHM,5%,0.25W	19701	5043CX22K00J92U
R363	316-0472-00	B010100	B078820	RES,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R363	315-0472-00	B078821		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R364	315-0103-00	B080498		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R365	316-0122-00	B010100	B078820	RES,FXD,CMPSN:1.2K OHM,10%.0.25W	01121	CB1221
R365	315-0122-00	B078821		RES,FXD,FILM:1.2K OHM,5%,0.25W	57668	NTR25J-E01K2
R366	316-0102-00	B010100	B078820	RES,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R366	315-0102-00	B078821		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R367	316-0182-00	B010100	B078820	RES,FXD,CMPSN:1.8K OHM,10%,0.25W	01121	CB1821
R367	315-0182-00	B078821		RES,FXD,FILM:1.8K OHM,5%,0.25W	57668	NTR25J-E1K8
R369	316-0102-00			RES,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R371	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
R372	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R373	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R376	307-0113-00			RES,FXD,CMPSN:5.1 OHM,5%,0.25W	01121	CB51G5
R379	316-0223-00	B010100	B078820	RES,FXD,CMPSN:22K OHM,10%,0.25W	01121	CB2231
R379	315-0223-00	B078821		RES,FXD,FILM:22K OHM,5%,0.25W	19701	5043CX22K00J92U
R403	316-0472-00	B010100	B078820	RES,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R403	315-0472-00	B078821		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R406	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R408	321-0414-00			RES,FXD,FILM:200K OHM,1%,0.125W,TC=T0	07716	CEAD20002F
R409	321-0385-00			RES,FXD,FILM:100K OHM,1%,0.125W,TC=T0	19701	5033ED100K0F
R418	301-0182-00			RES,FXD,FILM:1.8K OHM,5%,0.5W	19701	5053CX1K800J
R422	316-0101-00	B010100	B078820	RES,FXD,CMPSN:100 OHM,10%,0.25W	01121	CB1011
R422	315-0101-00	B078821		RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R425	323-0498-03			RES,FXD,FILM:1.5MEG OHM,0.25%,0.5W,TC=T9	19701	5053RC1M500C
R426	323-0498-03			RES,FXD,FILM:1.5MEG OHM,0.25%,0.5W,TC=T9	19701	5053RC1M500C
R427	321-0917-03			RES,FXD,FILM:2792K OHM,0.25%,0.125W,TC=T2	19701	5033RD27K20C
R429	321-0856-03			RES,FXD,FILM:330K OHM,0.25%,0.125W,TC=T2	19701	5033C330K0C
R431	321-0200-00			RES,FXD,FILM:1.18K OHM,1%,0.125W,TC=T0	19701	5033ED11K80F
R432	321-0830-03			RES,FXD,FILM:2.41K OHM,0.25%,0.125W,TC=T2	07716	CEAC24100C
R433	321-0827-03			RES,FXD,FILM:3.61K OHM,0.25%,0.125W,TC=T2	19701	5033RC3K610C
R434	321-0268-03			RES,FXD,FILM:6.04K OHM,0.25%,0.125W,T=T2	07716	CEAC60400C
R436	321-0234-00			RES,FXD,FILM:2.67K OHM,1%,0.125W,TC=T0	19701	5033ED2K67F
R438	311-0635-00			RES,VAR,NONWW:TRMR,1K OHM,0.5W	32997	3329H-G48-102
R446	315-0133-00			RES,FXD,FILM:13K OHM,5%,0.25W	19701	5043CX13K00J
R450	316-0103-00	B010100	B078820	RES,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R450	315-0103-00	B078821		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R452	321-0139-00			RES,FXD,FILM:274 OHM,1%,0.125W,TC=T0	07716	CEAD274R0F
R453	321-0260-00			RES,FXD,FILM:4.99K OHM,1%,0.125W,TC=T0	19701	5033ED4K990F
R454	315-0682-00	B060000		RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R455	316-0333-00	B010100	B078820	RES,FXD,CMPSN:33K OHM,10%,0.25W	01121	CB3331
R455	315-0333-00	B078821		RES,FXD,FILM:33K OHM,5%,0.25W	57668	NTR25J-E33K0
R456	316-0471-00	B010100	B078820	RES,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
R456	315-0471-00	B078821		RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
R458	316-0183-00	B010100	B078820	RES,FXD,CMPSN:18K OHM,10%,0.25W	01121	CB1831
R458	315-0183-00	B078821		RES,FXD,FILM:18K OHM,5%,0.25W	19701	5043CX18K00J
R459	316-0182-00	B010100	B078820	RES,FXD,CMPSN:1.8K OHM,10%,0.25W	01121	CB1821
R459	315-0182-00	B078821		RES,FXD,FILM:1.8K OHM,5%,0.25W	57668	NTR25J-E1K8
R460	311-0580-00			RES,VAR,NONWW:PNL,50K OHM,0.5W	01121	W-8155
R461	316-0333-00	B010100	B078820	RES,FXD,CMPSN:33K OHM,10%,0.25W	01121	CB3331
R461	315-0333-00	B078821		RES,FXD,FILM:33K OHM,5%,0.25W	57668	NTR25J-E33K0
R463	316-0183-00	B010100	B078820	RES,FXD,CMPSN:18K OHM,10%,0.25W	01121	CB1831
R463	315-0183-00	B078821		RES,FXD,FILM:18K OHM,5%,0.25W	19701	5043CX18K00J
R465	316-0471-00	B010100	B078820	RES,FXD,CMPSN:470 OHM,10%,0.25W	01121	CB4711
R465	315-0471-00	B078821		RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
R474	316-0104-00	B010100	B080425	RES,FXD,CMPSN:100K OHM,10%,0.25W	01121	CB1041
R474	315-0104-00	B080426		RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
R475	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R478	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R479	316-0223-00	B010100	B078820	RES,FXD,CMPSN:22K OHM,10%,0.25W	01121	CB2231
R479	315-0223-00	B078821		RES,FXD,FILM:22K OHM,5%,0.25W	19701	5043CX22K00J92U
R480	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R482	321-0356-00			RES,FXD,FILM:49.9K OHM,1%,0.125W,TC=T0	19701	5033ED49K90F
R483	316-0153-00	B010100	B078820	RES,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R483	315-0153-00	B078821		RES,FXD,FILM:15K OHM,5%,0.25W	19701	5043CX15K00J
R485	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25W	57668	NTR25J-E06K8
R487	321-0356-00			RES,FXD,FILM:49.9K OHM,1%,0.125W,TC=T0	19701	5033ED49K90F
R490	316-0153-00	B010100	B078820	RES,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R490	315-0153-00	B078821		RES,FXD,FILM:15K OHM,5%,0.25W	19701	5043CX15K00J

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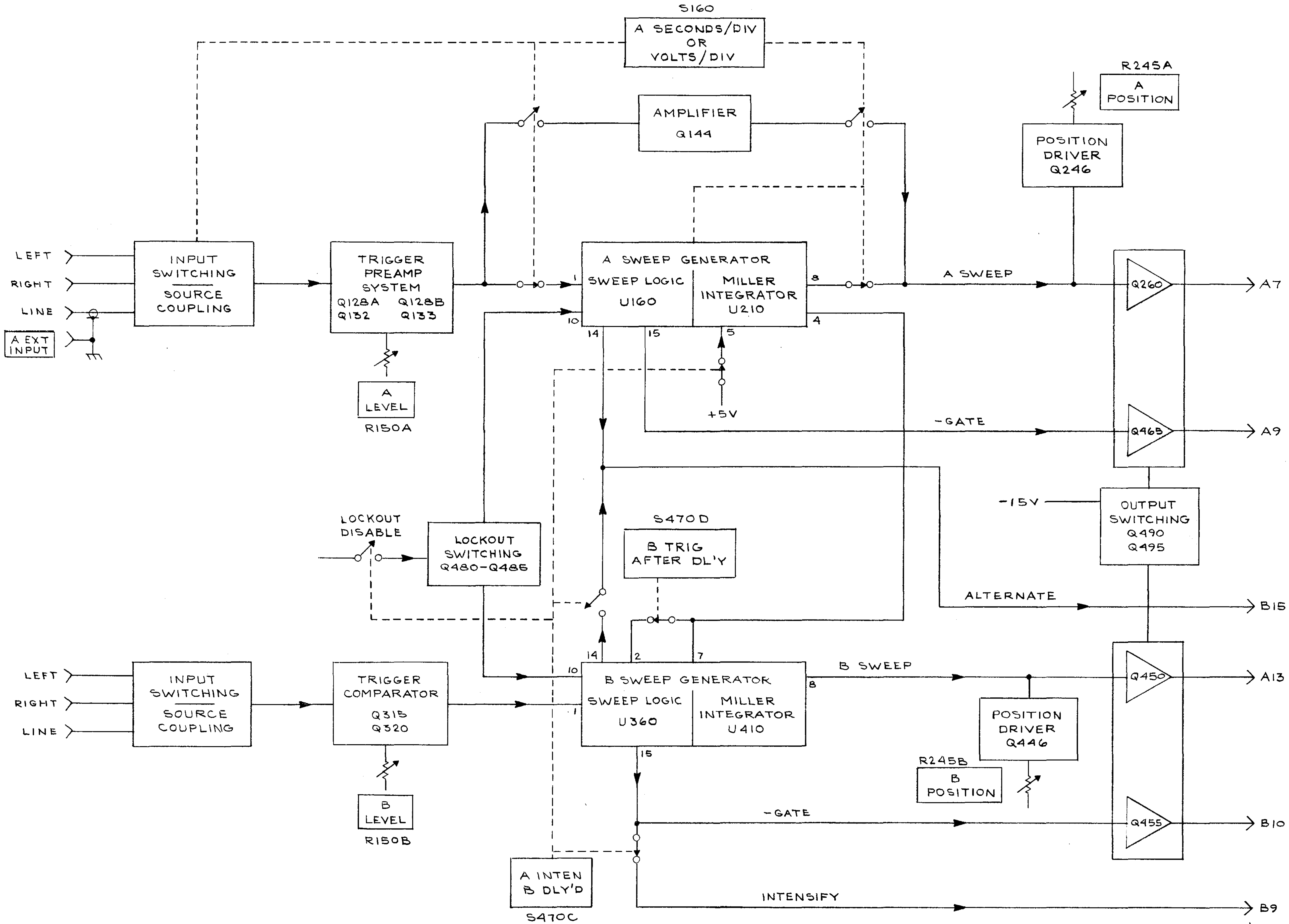
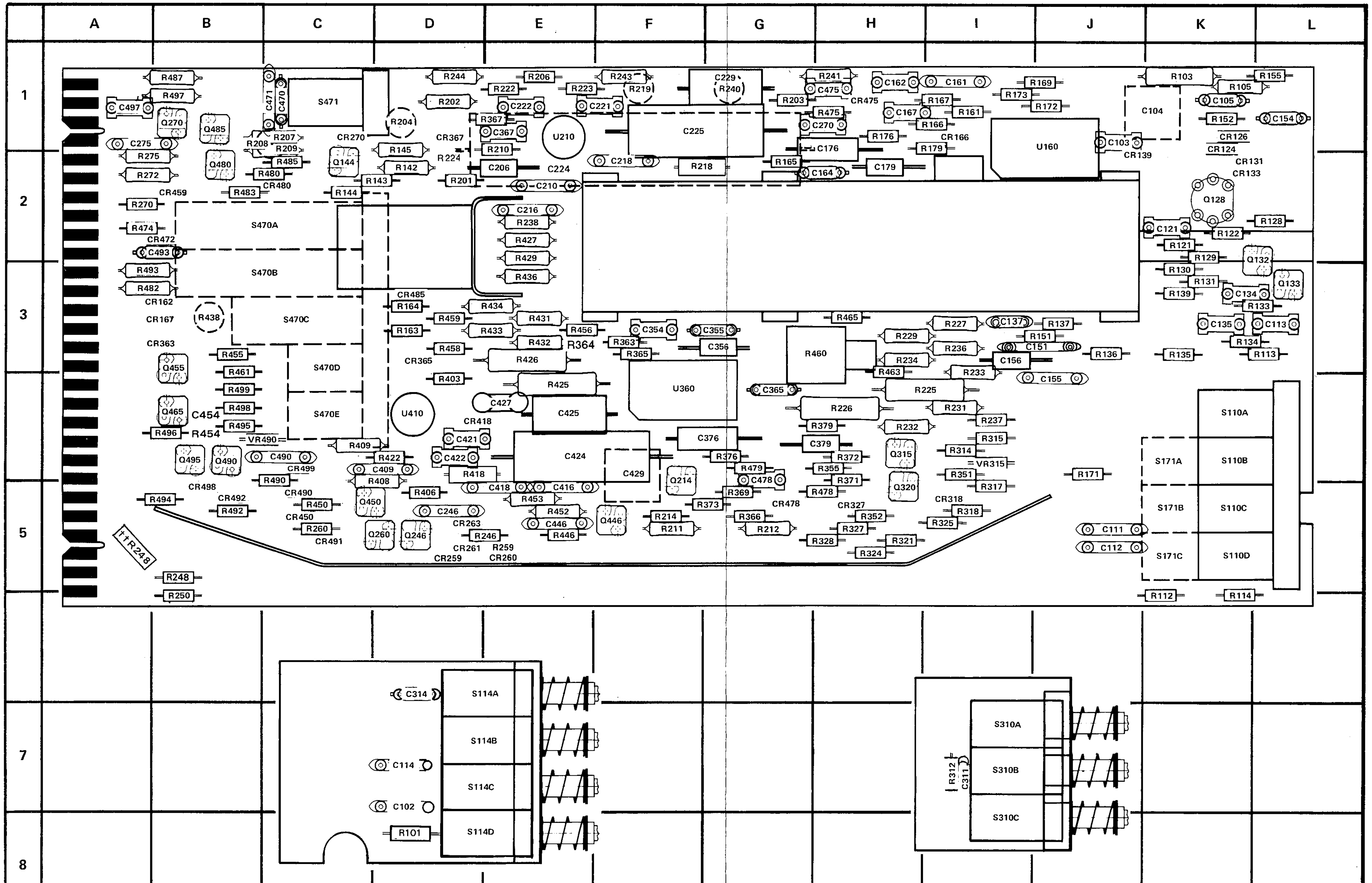
R492	316-0153-00	B010100	B078820	RES,FXD,CMPSN:15K OHM,10%,0.25W	01121	CB1531
R492	315-0153-00	B078821		RES,FXD,FILM:15K OHM,5%,0.25W	19701	5043CX15K00J
R493	321-0356-00			RES,FXD,FILM:49.9K OHM,1%,0.125W,TC=T0	19701	5033ED49K90F
R494	316-0102-00	B010100	B078820	RES,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R494	315-0102-00	B078821		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R495	316-0472-00	B010100	B078820	RES,FXD,CMPSN:4.7K OHM,10%,0.25W	01121	CB4721
R495	315-0472-00	B078821		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R496	316-0102-00	B010100	B078820	RES,FXD,CMPSN:1K OHM,10%,0.25W	01121	CB1021
R496	315-0102-00	B078821		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R497	321-0362-00			RES,FXD,FILM:57.6K OHM,1%,0.125W,TC=T0	19701	5043ED57K60F
R498	316-0103-00	B010100	B078820	RES,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R498	315-0103-00	B078821		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R499	316-0103-00	B010100	B078820	RES,FXD,CMPSN:10K OHM,10%,0.25W	01121	CB1031
R499	315-0103-00	B078821		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
S110	260-1213-00			SWITCH,PUSH:DPDT,1A,28VDC	31918	ORDER BY DESCR
S114	260-1269-00			SWITCH,PUSH:4 BUTTON,2 POLE,B SOURCE	31918	ORDER BY DESCR
S160	105-0267-00			ACTUATOR,CAM SW:TIME/DIV,FRONT	80009	105-0267-00
S171	260-1212-00			SWITCH,PUSH:4PDT,1A,28VDC	31918	ORDER BY DESCR
S310	260-1268-00			SWITCH,PUSH:3 BUTTON,2 POLE,FUNCTION	80009	260-1268-00
S470	260-1270-00	B010100	B063007	SWITCH,PUSH:5 STATION,3 PUSH-PUSH	59821	2KBM021200500
S470	260-1270-01	B063008	B066303	SWITCH,PUSH:5 STATION,3 PUSH-PUSH	80009	260-1270-01
S470	260-1270-00	B066304		SWITCH,PUSH:5 STATION,3 PUSH-PUSH	59821	2KBM021200500
S471	260-1211-00			SWITCH,PUSH:1A,28VDC	31918	601348
U160	155-0056-00			MICROCKT,DGTL:SWEEP CONTROL	80009	155-0056-00
U210	155-0042-01	B010100	B019999	MICROCKT,LINEAR:MILLER INTEGRATOR	80009	155-0042-01
U210	155-0042-03	B020000	B066184	MICROCKT,LINEAR:MILLER INTEGRATOR	80009	155-0042-03
U210	155-0028-00	B066185		MICROCKT,LINEAR:MILLER INTEGRATOR	80009	155-0028-00
U360	155-0056-00			MICROCKT,DGTL:SWEEP CONTROL	80009	155-0056-00
U410	155-0042-01	B010100	B019999	MICROCKT,LINEAR:MILLER INTEGRATOR	80009	155-0042-01
U410	155-0042-03	B020000	B066184	MICROCKT,LINEAR:MILLER INTEGRATOR	80009	155-0042-03
U410	155-0028-00	B066185		MICROCKT,LINEAR:MILLER INTEGRATOR	80009	155-0028-00
VR315	152-0279-00			SEMICOND DVC,DI:ZEN,SI,5.1V,5%,0.4W,DO-7	14552	TD3810989
VR490	152-0149-00			SEMICOND DVC,DI:ZEN,SI,10V,5%,0.4W,DO-7	15238	Z5406


S160
A SECONDS/DIV OR VOLTS/DIV
AMPLIFIER Q144
R245A
A POSITION
POSITION DRIVER Q246
LEFT
RIGHT
LINE
A EXT INPUT
INPUT SWITCHING
SOURCE COUPLING
TRIGGER PREAMP SYSTEM Q128A Q128B Q132 Q133
A LEVEL
R150A
A SWEEP GENERATOR
SWEEP LOGIC U160
MILLER INTEGRATOR U210
+5V
A SWEEP
Q260
A7
-GATE
Q465
A9
-15V
OUTPUT SWITCHING Q490 Q495
LOCKOUT DISABLE
LOCKOUT SWITCHING Q480-Q486
S470D
B TRIG AFTER DL'Y
ALTERNATE
B15
LEFT
RIGHT
LINE
INPUT SWITCHING
SOURCE COUPLING
TRIGGER COMPARATOR Q315 Q320
B LEVEL
R150B
B SWEEP GENERATOR
SWEEP LOGIC U360
MILLER INTEGRATOR U410
B SWEEP
Q450
A13
POSITION DRIVER Q446
R245B
B POSITION
-GATE
Q455
B10
A INTEN B DLY'D
S470C
INTENSIFY
B9

Scan by Zenith

PARTS LOCATION GRID

5B12N



Dashed lines indicate components located on reverse side of board.

1141-8A

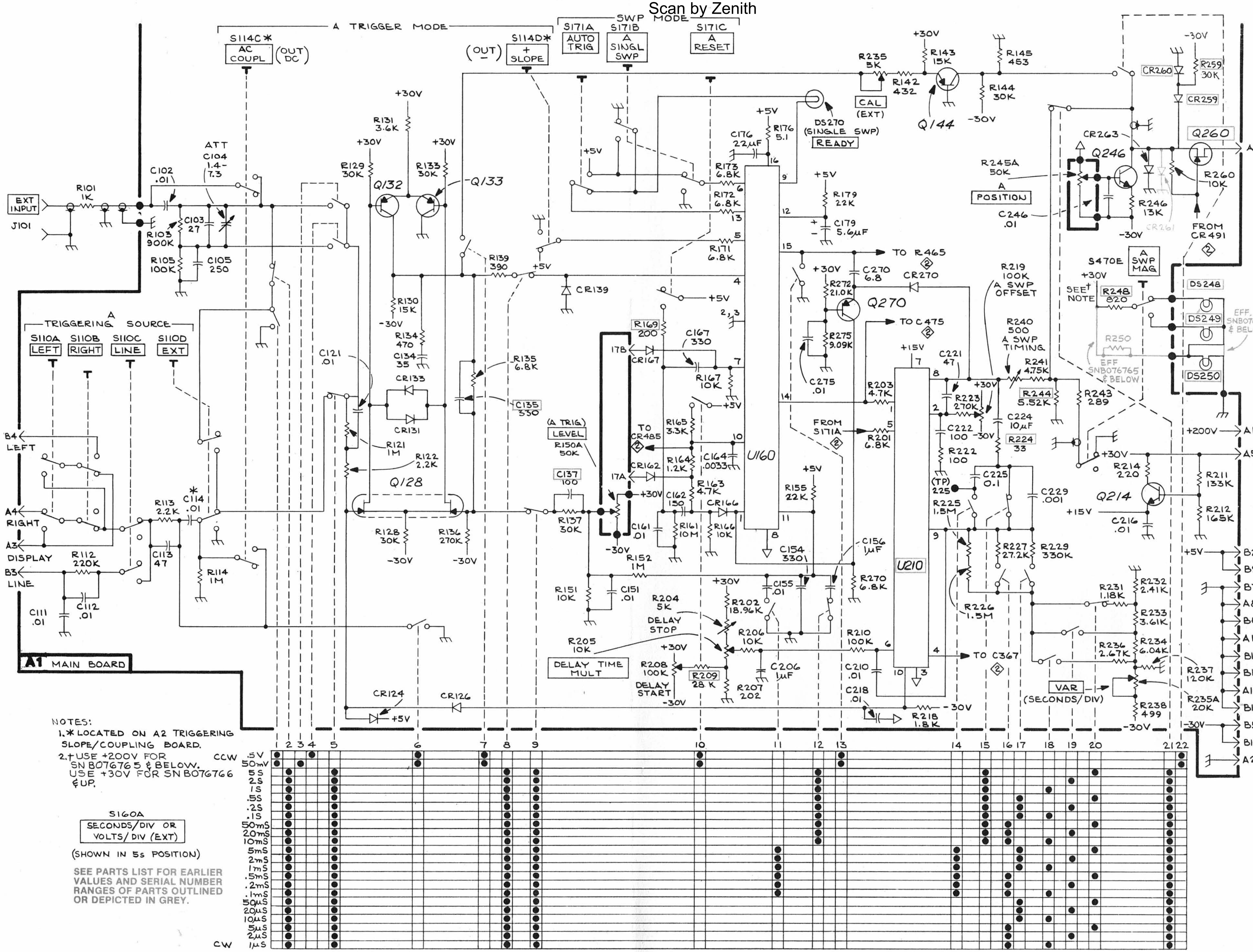
REV FEB 1987

CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC	CKT NO	GRID LOC
C102	D7	CR124	K1	R130	K3	R259*	E5	R479	G4
C103	J1	CR126	K1	R131	K3	R260	C5	R480	C2
C104	K1	CR131	K2	R133	K3	R270	A2	R482	A3
C105	K1	CR133	K2	R134	K3	R272	A2	R483	B2
C111	J5	CR139	J2	R135	K3	R275	A2	R485	C2
C112	J5	CR162	B3	R136	J3	R312	I7	R487	B1
C113	L3	CR166	I1	R137	J3	R314	I4	R490	C4
C114	D7	CR167	B3	R139	K3	R315	I4	R492	B5
C121	K2	CR259*	D5	R142	D2	R317	I5	R493	A3
C134	K3	CR260*	E5	R143	C2	R318	I5	R494	B5
C135	K3	CR261*	D5	R144	C2	R321	H5	R495	B4
C137	I3	CR263	D5	R145	D2	R324	H5	R496	B4
C151	I3	CR270	C1	R151	J3	R325	I5	R497	B1
C154	L1	CR318	I5	R152	K1	R327	H5	R498	B4
C155	J4	CR327	H5	R155	L1	R328	H5	R499	B4
C156	I3	CR363	B3	R161	I1	R351	I4		
C161	I1	CR365	D3	R163	D3	R352	H5	S110A	K4
C162	H1	CR367	D1	R164	D3	R355	H4	S110B	K4
C164	H2	CR418	D4	R165	G2	R363	F3	S110C	K5
C167	H1	CR450	C5	R166	I1	R364*	E3	S110D	K5
C176	H1	CR459	B2	R167	I1	R365	F3	S114A	E6
C179	H2	CR472	B2	R169	J1	R366	G5	S114B	E7
C206	E2	CR475	H1	R171	J4	R367	E1	S114C	E7
C210	E2	CR478	G5	R172	J1	R369	G5	S114D	E8
C216	E2	CR480	C2	R173	I1	R371	H4	S171A	K4
C218	F2	CR485	D3	R176	H1	R372	H4	S171B	K5
C221	F1	CR490	C5	R179	I1	R373	G5	S171C	K5
C222	E1	CR491	C5	R201	D2	R376	G4	S310A	I7
C224	E2	CR492	B5	R202	D1	R379	H4	S310B	I7
C225	F1	CR498	B5	R203	G1	R403	D4	S310C	I8
C229	G1	CR499	C4	R204	D1	R406	D5	S470A	C2
C246	D5			R206	E1	R408	D4	S470B	C3
C270	H1	Q128	K2	R207	C1	R409	C4	S470C	C3
C275	A1	Q132	K2	R208	B1	R418	D4	S470D	C4
C311	I7	Q133	L3	R209	C1	R422	D4	S470E	C4
C314	D6	Q144	C2	R210	E1	R425	E4	S471	C1
C354	F3	Q214	F5	R211	F5	R426	E3		
C355	G3	Q246	D5	R212	G5	R427	E2	U160	J1
C356	G3	Q260	D5	R214	F5	R429	E2	U210	E1
C365	G4	Q270	B1	R218	F2	R431	E3	U360	F4
C367	E1	Q315	H4	R219	F1	R432	E3	U410	D4
C376	F4	Q320	H5	R222	E1	R433	E3		
C379	H4	Q446	F5	R223	E1	R434	E3	VR315	I4
C409	D4	Q450	C5	R224*†	D2	R436	E3	VR490	B4
C416	E5	Q455	B3	R225	H4	R438	B3		
C418	E5	Q465	B4	R226	H4	R446	D5		
C421*	D4	Q480	B2	R227	I3	R450	C5		
C422	D4	Q485	B1	R229	H3	R452	E5		
C424	E4	Q490	B4	R231	I4	R453	E5		
C425	E4	Q495	B4	R232	H4	R454*	B4		
C427	E4			R233	I4	R455	B3		
C429	F4	R101	D8	R234	H3	R456	E3		
C446	E5	R103	K1	R236	I3	R458	D3		
C454*	B4	R105	K1	R237	I4	R459	D3		
C470	C1	R112	K6	R238	E2	R460	H3		
C471	C1	R113	K3	R240	G1	R461	B3		
C475	H1	R114	K6	R241	H1	R463	H4		
C478	G4	R121	K2	R243	F1	R465	H3		
C490	C4	R122	K2	R244	D1	R474	A2		
C493	B2	R128	L2	R246	E5	R475	H1		
C497	A1	R129	K2	R248	B5	R478	H5		
				R248††	A5				
				R250*	B6				

*See Parts List for serial number ranges.

†Located on back of board.

††New Location of R248 for SN B076766 and up.



NOTES:
1. * LOCATED ON A2 TRIGGERING SLOPE/COUPLING BOARD.
2. † USE +200V FOR SN B076765 & BELOW. USE +30V FOR SN B076766 & UP.

S160A
SECONDS/DIV OR VOLTS/DIV (EXT)

(SHOWN IN 5s POSITION)

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

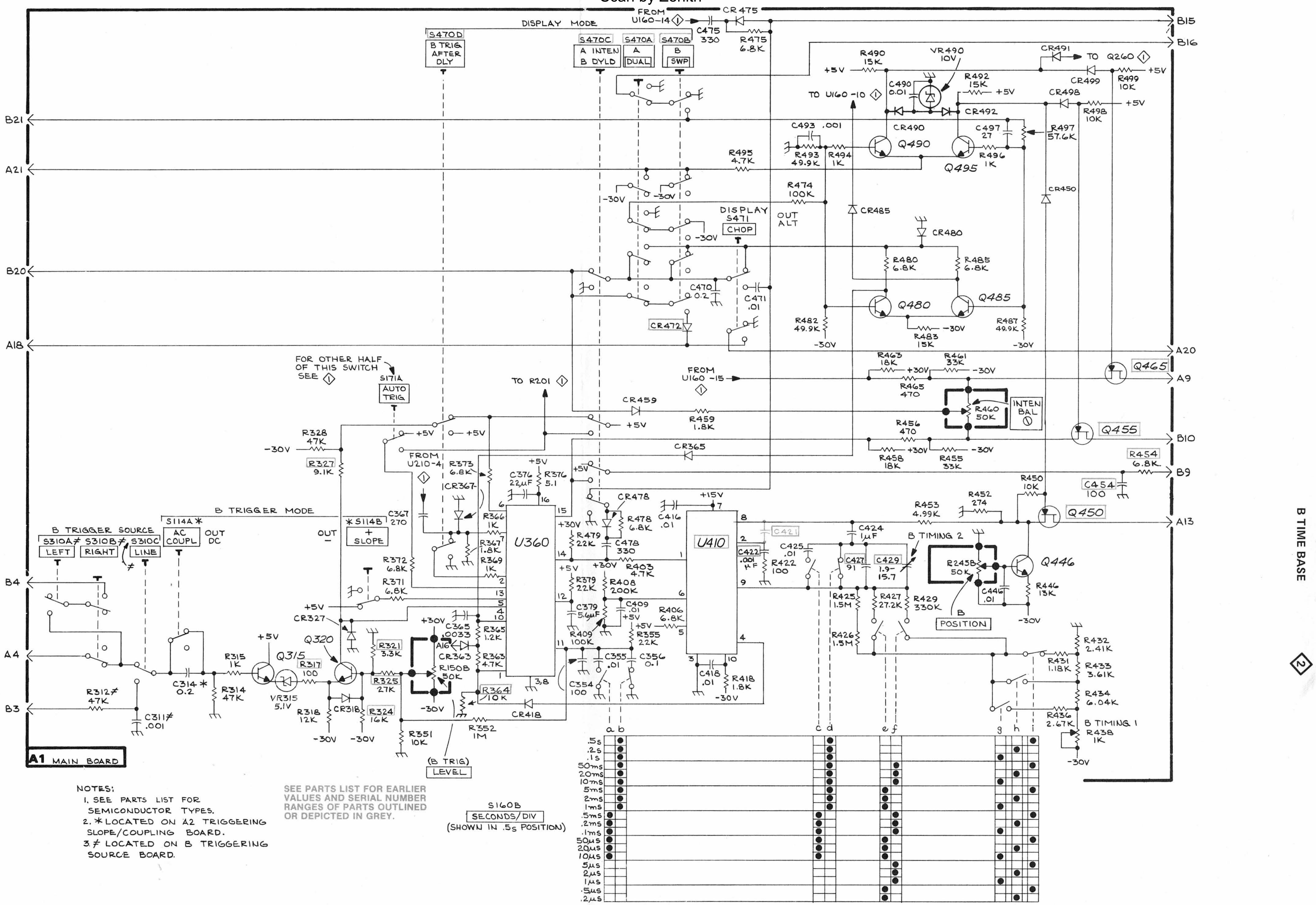
5B12N

1141-9
REV MAR 1985

A TIME BASE ⟨1⟩

RH 773

Scan by Zenith



NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
2. * LOCATED ON A2 TRIGGERING SLOPE/COUPLING BOARD.
3 ≠ LOCATED ON B TRIGGERING SOURCE BOARD.

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

S160B
SECONDS/DIV
(SHOWN IN .5s POSITION)

B TIME BASE

5B12N

1141-10
REV FEB 1987

B TIME BASE ② 273 RH

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000 Part first added at this serial number

00X Part removed after this serial number

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
--- * ---
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
--- * ---
Parts of Detail Part
Attaching parts for Parts of Detail Part
--- * ---

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol --- * --- indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

"	INCH	ELCTRN	ELECTRON	IN	INCH	SE	SINGLE END
#	NUMBER SIZE	ELEC	ELECTRICAL	INCAND	INCANDESCENT	SECT	SECTION
ACTR	ACTUATOR	ELCTLT	ELECTROLYTIC	INSUL	INSULATOR	SEMICOND	SEMICONDUCTOR
ADPTR	ADAPTER	ELEM	ELEMENT	INTL	INTERNAL	SHLD	SHIELD
ALIGN	ALIGNMENT	EPL	ELECTRICAL PARTS LIST	LPHLDR	LAMPHOLDER	SHLDR	SHOULDERED
AL	ALUMINUM	EQPT	EQUIPMENT	MACH	MACHINE	SKT	SOCKET
ASSEM	ASSEMBLED	EXT	EXTERNAL	MECH	MECHANICAL	SL	SLIDE
ASSY	ASSEMBLY	FIL	FILLISTER HEAD	MTG	MOUNTING	SLFLKG	SELF-LOCKING
ATTEN	ATTENUATOR	FLEX	FLEXIBLE	NIP	NIPPLE	SLVG	SLEEVING
AWG	AMERICAN WIRE GAGE	FLH	FLAT HEAD	NON WIRE	NOT WIRE WOUND	SPR	SPRING
BD	BOARD	FLTR	FILTER	OBD	ORDER BY DESCRIPTION	SQ	SQUARE
BRKT	BRACKET	FR	FRAME or FRONT	OD	OUTSIDE DIAMETER	SST	STAINLESS STEEL
BRS	BRASS	FSTNR	FASTENER	OVH	OVAL HEAD	STL	STEEL
BRZ	BRONZE	FT	FOOT	PH BRZ	PHOSPHOR BRONZE	SW	SWITCH
BSHG	BUSHING	FXD	FIXED	PL	PLAIN or PLATE	T	TUBE
CAB	CABINET	GSKT	GASKET	PLSTC	PLASTIC	TERM	TERMINAL
CAP	CAPACITOR	HDL	HANDLE	PN	PART NUMBER	THD	THREAD
CER	CERAMIC	HEX	HEXAGON	PNH	PAN HEAD	THK	THICK
CHAS	CHASSIS	HEX HD	HEXAGONAL HEAD	PWR	POWER	TNSN	TENSION
CKT	CIRCUIT	HEX SOC	HEXAGONAL SOCKET	RCPT	RECEPTACLE	TPG	TAPPING
COMP	COMPOSITION	HLCPS	HELICAL COMPRESSION	RES	RESISTOR	TRH	TRUSS HEAD
CONN	CONNECTOR	HLEXT	HELICAL EXTENSION	RGD	RIGID	V	VOLTAGE
COV	COVER	HV	HIGH VOLTAGE	RLF	RELIEF	VAR	VARIABLE
CPLG	COUPLING	IC	INTEGRATED CIRCUIT	RTNR	RETAINER	W/	WITH
CRT	CATHODE RAY TUBE	ID	INSIDE DIAMETER	SCH	SOCKET HEAD	WSHR	WASHER
DEG	DEGREE	IDENT	IDENTIFICATION	SCOPE	OSCILLOSCOPE	XFMR	TRANSFORMER
DWR	DRAWER	IMPLR	IMPELLER	SCR	SCREW	XSTR	TRANSISTOR

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

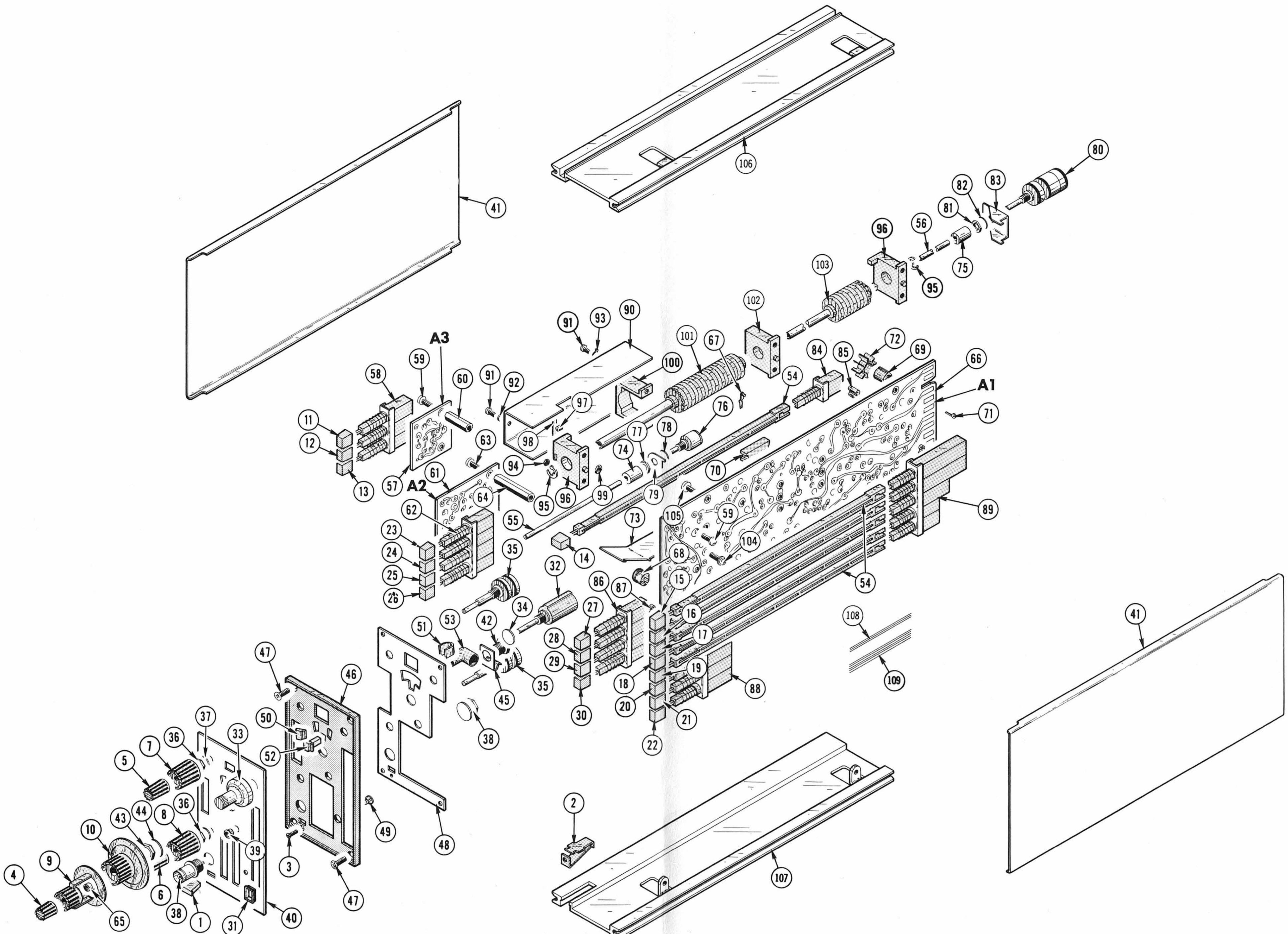
Mfr. Code	Manufacturer	Address	City, State, Zip Code
05129	KILO ENGINEERING CO	2015 D	LA VERNE CA 91750
05820	EG AND G WAKEFIELD ENGINEERING	60 AUDUBON RD	WAKEFIELD MA 01880
07416	NELSON NAME PLATE CO	3191 CASITAS	LOS ANGELES CA 90039
08261	SPECTRA-STRIP AN ELTRA CO	7100 LAMPSON AVE	GARDEN GROVE CA 92642
09772	WEST COAST LOCKWASHER CO INC	16730 E JOHNSON DRIVE P O BOX 3588	CITY OF INDUSTRY CA 91744
09922	BURNDY CORP	RICHARDS AVE	NORWALK CT 06852
12327	FREEWAY CORP	9301 ALLEN DR	CLEVELAND OH 44125
13511	AMPHENOL CADRE DIV BUNKER RAMO CORP		LOS GATOS CA
28520	HEYCO MOLDED PRODUCTS	147 MICHIGAN AVE P O BOX 160	KENILWORTH NJ 07033
45722	USM CORP., PARKER-KALON FASTENER DIV		CAMPBELLSVILLE, KY 42718
71785	TRW INC TRW CINCH CONNECTORS	1501 MORSE AVE	ELK GROVE VILLAGE IL 60007
73743	FISCHER SPECIAL MFG CO	446 MORGAN ST	CINCINNATI OH 45206
74445	HOLO-KROME CO	31 BROOK ST	WEST HARTFORD CT 06110
77900	SHAKEPROOF DIV OF ILLINOIS TOOL WORKS	SAINT CHARLES RD	ELGIN IL 60120
79136	WALDES KOHINOOR INC	47-16 AUSTEL PLACE	LONG ISLAND CITY NY 11101
80009	TEKTRONIX INC	4900 S W GRIFFITH DR P O BOX 500	BEAVERTON OR 97077
83385	MICRODOT MANUFACTURING INC GREER-CENTRAL DIV	3221 W BIG BEAVER RD	TROY MI 48098
93907	TEXTRON INC CAMCAR DIV	600 18TH AVE	ROCKFORD IL 61101
TK0392	NORTHWEST FASTENER SALES INC	7923 SW CIRRUS DRIVE	BEAVERTON OR 97005
TK0435	LEWIS SCREW CO	4114 S PEORIA	CHICAGO IL 60609
TK1319	MORELLIS Q & D PLASTICS	1812 16-TH AVE	FOREST GROVE OR 97116
TK1665	PORTLAND DIE AND STAMPING INC	4805 SE 26TH	PORTLAND OR 97202

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-1	366-1286-00	B010100	B049999	1	KNOB:SIL GY,0.5 X 0.2 X 0.375	80009	366-1286-00
	366-1286-03	B050000	B065857	1	KNOB:GY,0.5 X 0.2 X 0.375	80009	366-1286-03
	366-1690-00	B065858		1	KNOB,LATCH:SIL GY,0.53 X 0.23 X 1.059	80009	366-1690-00
	214-1840-00	B050000	B065858	1	PIN,KNOB SECRG:0.12 L X 0.094-0.1 OD,ACETAL	80009	214-1840-00
-2	214-1513-00	B010100	B049999	1	LCH,PL-IN RTNG:PLASTIC	80009	214-1513-00
	214-1513-01	B050000	B065857	1	LCH,PL-IN RTNG:PLASTIC	80009	214-1513-01
	105-0719-00	B065858		1	LATCH,RETAINING:PLUG-IN	80009	105-0719-00
					(ATTACHING PARTS)		
-3	213-0254-00			1	SCREW,TPG,TF:2-32 X 0.25,TYPE B,FLH,100 DEG	45722	ORDER BY DESCR
					(END ATTACHING PARTS)		
	105-0718-00	B065858	B066433	1	BAR,LATCH RLSE:	80009	105-0718-00
	105-0718-01	B066434		1	BAR,LATCH RLSE:	80009	105-0718-01
-4	366-1346-00			1	KNOB:RED,A CAL,0.08ID X 0.392 OD X 0.466 H	80009	366-1346-00
	213-0153-00			1	.SETSCREW:5-40 X 0.125,STL	TK0392	ORDER BY DESCR
-5	366-1327-00			1	KNOB:GY,0.8 ID X 0.392 OD X 0.466 H	80009	366-1327-00
	213-0153-00			1	.SETSCREW:5-40 X 0.125,STL	TK0392	ORDER BY DESCR
-6	366-1327-00			1	KNOB:GY,0.8 ID X 0.392 OD X 0.466 H	80009	366-1327-00
	213-0153-00			1	.SETSCREW:5-40 X 0.125,STL	TK0392	ORDER BY DESCR
-7	366-1326-00			1	KNOB:GY,0.127 ID X 0.588 OD X 0.6 H	80009	366-1326-00
	213-0153-00			1	.SETSCREW:5-40 X 0.125,STL	TK0392	ORDER BY DESCR
-8	366-1326-00			1	KNOB:GY,0.127 ID X 0.588 OD X 0.6 H	80009	366-1326-00
	213-0153-00			1	.SETSCREW:5-40 X 0.125,STL	TK0392	ORDER BY DESCR
-9	366-1350-00	B010100	B079429	1	KNOB:GY,SEC/DIV,0.252 ID X 1.15 OD X 0.51 H	80009	366-1350-00
	366-1350-01	B079430		1	KNOB:CLR,SEC/DIV,0.25 ID X 1.15 OD X 0.51 H	80009	366-1350-01
	213-0153-00			2	.SETSCREW:5-40 X 0.125,STL	TK0392	ORDER BY DESCR
-10	366-1343-00	B010100	B078679	1	KNOB:GY,V/DIV,0.252 ID X 1.531 OD X 0.55 H	80009	366-1343-00
	366-1343-01	B078680		1	KNOB:GY,V/DIV,0.252 ID X 1.531 OD X 0.55 H	80009	366-1343-01
	213-0153-00			2	.SETSCREW:5-40 X 0.125,STL	TK0392	ORDER BY DESCR
-11	366-1257-57			1	PUSH BUTTON:SIL GY,LEFT	80009	366-1257-57
-12	366-1257-58			1	PUSH BUTTON:SIL GY,RIGHT	80009	366-1257-58
-13	366-1257-23			1	PUSH BUTTON:SIL GY,LINE	80009	366-1257-23
-14	366-1257-31			1	PUSH BUTTON:SIL GY,CHOP	80009	366-1257-31
-15	366-1257-33			1	PUSH BUTTON:SIL GY,A DUAL	80009	366-1257-33
-16	366-1257-59			1	PUSH BUTTON:SIL GY,SWP B	80009	366-1257-59
-17	366-1257-35			1	PUSH BUTTON:SIL GY,A INTEN B DEL'D	80009	366-1257-35
-18	366-1257-36			1	PUSH BUTTON:SIL GY,AUTO TRIG	80009	366-1257-36
-19	366-1257-37			1	PUSH BUTTON:SIL GY,A SWP MAG	80009	366-1257-37
-20	366-1257-26			1	PUSH BUTTON:SIL GY,AUTO TRIG	80009	366-1257-26
-21	366-1328-19			1	PUSH BUTTON:CHARCOAL,A SINGL SWP	80009	366-1328-19
-22	366-1328-16			1	PUSH BUTTON:CHARCOAL,A RESET	80009	366-1328-16
-23	366-1257-27			1	PUSH BUTTON:SIL GY,AC COUPL	80009	366-1257-27
-24	366-1257-28			1	PUSH BUTTON:SIL GY,+ SLOPE	80009	366-1257-28
-25	366-1328-17			1	PUSH BUTTON:CHARCOAL,AC COUPL	80009	366-1328-17
-26	366-1328-22			1	PUSH BUTTON:CHARCOAL,+SLOPE HT	80009	366-1328-22
-27	366-1328-15			1	PUSH BUTTON:CHARCOAL,LEFT COMP	80009	366-1328-15
-28	366-1328-20			1	PUSH BUTTON:CHARCOAL,OSITE RIGHT	80009	366-1328-20
-29	366-1328-18			1	PUSH BUTTON:CHARCOAL,LINE	80009	366-1328-18
-30	366-1328-21			1	PUSH BUTTON:CHARCOAL,EXT	80009	366-1328-21
-31	426-0681-00			20	FRAME,PUSH BTN:	80009	426-0681-00
-32	----- -----			1	RESISTOR,VAR:(SEE R205 REPL)		
					(ATTACHING PARTS)		
-33	331-0291-00			1	DIAL,CONTROL:10 TURNS W/O BRAKE	05129	781-S 3
-34	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,STL	77900	1214-05-00-0541C
					(END ATTACHING PARTS)		
-35	----- -----			2	RESISTOR,VAR:(SEE R150 AND R245 REPL)		
					(ATTACHING PARTS)		
-36	210-0583-00			2	NUT,PLAIN,HEX:0.25-32 X 0.312,BRS CD PL	73743	2X-20319-402
-37	210-0940-00			2	WASHER,FLAT:0.25 ID X 0.375 OD X 0.02,STL	12327	ORDER BY DESCR
	210-0046-00	B031040		2	WASHER,LOCK:0.261 ID,INTL,0.018 THK,STL	77900	1214-05-00-0541C
					(END ATTACHING PARTS)		
-38	131-0955-00			1	CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
-39	358-0378-00			1	BUSHING,SLEEVE:0.131 ID X 0.18 OD X 0.125 L	80009	358-0378-00
-40	333-1386-00	B010100	B078679	1	PANEL,FRONT:	80009	333-1386-00
	333-1386-01	B078680		1	PANEL,FRONT:	80009	333-1386-01
-41	337-1399-00			2	SHIELD,ELEC:SIDE	80009	337-1399-00
-42	358-0029-00			1	BSHG,MACH THD:0.375-32 X 0.5 HEX,BRS NP	80009	358-0029-00
					(ATTACHING PARTS)		
-43	210-0590-00			1	NUT,PLAIN,HEX:0.375-32 X 0.438 BRS CD PL	73743	28269-402

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-44	210-0012-00			1	WASHER,LOCK:0.384 ID,INTL,0.022 THK,STL	09772	ORDER BY DESCR
-45	344-0195-01	B010100	B049999	1	CLIP,ELECTRICAL:GROUNDING,PH BRZ ALBALOY PL	80009	344-0195-01
					(END ATTACHING PARTS)		
-46	386-1915-00			1	SUBPANEL,FRONT:	80009	386-1915-00
					(ATTACHING PARTS)		
-47	213-0229-00			4	SCREW,TPG,TF:6-20 X 0.375,TYPE B,FLH,100 DEG,STL	93907	ORDER BY DESCR
					(END ATTACHING PARTS)		
	358-0378-00	B010100	B065977	1	BUSHING,SLEEVE:0.131 ID X 0.18 OD X 0.125 L	80009	358-0378-00
	358-0599-00	B065978		1	BUSHING,SLEEVE:0.125 ID X 0.25 OD X 0.234	28520	B-187-125
-48	337-1395-00			1	SHIELD,ELEC:SUBPANEL	80009	337-1395-00
-49	378-0541-00			1	LENS,LIGHT:FROSTED,PLASTIC	80009	378-0541-00
-50	136-0430-00			2	LIGHT,INDICATOR:U/W 0.244 OD LAMP	80009	136-0430-00
-51	337-1494-00			2	SHIELD,LIGHT:LAMP	80009	337-1494-00
-52	378-0694-00			1	LENS,LIGHT:WHITE,FLUSH MOUNT	80009	378-0694-00
-53	200-1254-00			1	COVER,LAMP:	TK1319	ORDER BY DESCR
-54	384-1060-00			6	EXTENSION SHAFT:7.831 L	80009	384-1060-00
-55	384-1065-00			1	EXTENSION SHAFT:3.485 L X 0.125 OD,AL	80009	384-1065-00
-56	384-1105-00			1	EXTENSION SHAFT:8.241 L X 0.081 OD,SST	80009	384-1105-00
-57	----- -----			1	CKT BOARD ASSY:AUXILIARY #1(SEE A3 REPL)		
-58	----- -----			1	.SWITCH,PUSH:(SEE S310 REPL)		
					(ATTACHING PARTS FOR CKT BD)		
-59	211-0504-00			4	SCREW,MACHINE:6-32 X 0.250,PNH,STL	TK0435	ORDER BY DESCR
-60	129-0295-00			2	SPACER,POST:0.894 L,6-32 EA END,AL,0.25 HEX	80009	129-0295-00
					(END ATTACHING PARTS)		
-61	----- -----			1	CKT BOARD ASSY:AUXILIARY #2(SEE A2 REPL)		
-62	----- -----			1	.SWITCH,PUSH:(SEE S114 REPL)		
					(ATTACHING PARTS FOR CKT BD)		
-63	211-0504-00			4	SCREW,MACHINE:6-32 X 0.250,PNH,STL	TK0435	ORDER BY DESCR
-64	361-0068-00			2	SPACER,POST:1.23 L W/6-32 THD EA END,AL, 0.25 HEX	80009	361-0068-00
					(END ATTACHING PARTS)		
-65	358-0414-00			1	BUSHING,SLEEVE:0.125 ID X 0.312 OD X 0.21 L	80009	358-0414-00
-66	----- -----			1	CKT BOARD ASSY:MAIN(SEE A1 REPL)		
-67	131-0604-00			31	.CONTACT,ELEC:CKT BD SW,SPR,CU BE	80009	131-0604-00
-68	136-0235-00			1	.SKT,PL-IN ELEK:TRANSISTOR,6 CONTACT	71785	133-96-12-062
-69	136-0241-00			2	.SKT,PL-IN ELEK:MICROCIRCUIT,10 CONT,PCB MT	71785	133-99-12-064
-70	136-0260-02	B010100	B079149	2	.SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CL	09922	DILB16P-108T
	136-0729-00	B079150		2	.SKT,PL-IN ELEK:MICROCKT,16 CONTACT	09922	DILB16P-108T
-71	214-0579-00			4	.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-72	214-1291-00			2	.HEAT SINK,XSTR:TO-5,SIL BRZ PTD BLACK	05820	207SB
-73	337-1503-00			1	.SHIELD,ELEC:MAIN CKT BD	80009	337-1503-00
-74	376-0029-00			1	.CPLG,SHAFT,RGD:0.128 ID X 0.312 OD,AL	80009	376-0029-00
	213-0075-00			2	..SETSCREW:4-40 X 0.094,STL	74445	ORDER BY DESCR
-75	376-0039-00	B010100	B031039	1	.CPLG,SHAFT,RGD:0.082 & 0.128 ID,AL	80009	376-0039-00
	376-0050-00	B031040		1	.CPLG,SHAFT,FLEX:0.081 & 0.127 ID,PP	80009	376-0050-00
	213-0075-00			2	..SETSCREW:4-40 X 0.094,STL	74445	ORDER BY DESCR
	213-0022-00			4	..SETSCREW:4-40 X 0.188,STL	74445	ORDER BY DESCR
	354-0251-00			2	..RING,CPLG:0.251 ID X 0.375 OD X 0.187,AL	80009	354-0251-00
	376-0046-00			1	..CPLG,SHAFT,FLEX:0.25 ID X 0.243,PP	80009	376-0046-00
-76	----- -----			1	.RESISTOR,VAR:(SEE R460 REPL)		
					.(ATTACHING PARTS)		
-77	210-0583-00			1	.NUT,PLAIN,HEX:0.25-32 X 0.312,BRS CD PL	73743	2X-20319-402
-78	210-0046-00			1	.WASHER,LOCK:0.261 ID,INTL,0.018 THK,STL	77900	1214-05-00-0541C
-79	387-0794-00			1	.PLATE,CMPNT MTG:VAR RESISTOR,BRASS	TK1665	ORDER BY DESCR
					.(END ATTACHING PARTS)		
-80	----- -----			1	.RESISTOR VAR:(SEE R235 REPL)		
					.(ATTACHING PARTS)		
-81	210-0583-00			1	.NUT,PLAIN,HEX:0.25-32 X 0.312,BRS CD PL	73743	2X-20319-402
-82	210-0046-00			1	.WASHER,LOCK:0.261 ID,INTL,0.018 THK,STL	77900	1214-05-00-0541C
-83	407-0803-00			1	.BRACKET,ELEC SW:BRASS	80009	407-0803-00
					.(END ATTACHING PARTS)		
-84	----- -----			1	.SWITCH,PUSH:(SEE S471 REPL)		
					.(ATTACHING PARTS)		
-85	361-0383-00			2	.SPACER,PB SW:0.33 L,CHARCOAL,POLYCARBONATE	80009	361-0383-00
					.(END ATTACHING PARTS)		
-86	----- -----			1	.SWITCH,PUSH:(SEE S110 REPL)		
					.(ATTACHING PARTS)		

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-87	361-0384-00			4	.SPACER,PB SW:0.133 L,RED POLYCARBONATE	80009	361-0384-00
					.(END ATTACHING PARTS)		
-88	----- -----			1	.SWITCH,PUSH:(SEE S171 REPL)		
					.(ATTACHING PARTS)		
	361-0382-00			4	.SPACER,PB SW:0.275 L,BROWN POLYCARBONATE	80009	361-0382-00
					.(END ATTACHING PARTS)		
-89	----- -----			1	.SWITCH,PUSH(SEE S470 REPL)		
					.(ATTACHING PARTS)		
	361-0384-00			8	.SPACER,PB SW:0.133 L,RED POLYCARBONATE	80009	361-0384-00
					.(END ATTACHING PARTS)		
	105-0276-00			1	.ACTR ASSY,CAM S:TIME/DIV	80009	105-0276-00
-90	200-1271-00			1	..COVER,CAM SW:22 & 9 ELEMENTS	80009	200-1271-00
					..(ATTACHING PARTS)		
-91	211-0079-00			5	..SCREW,MACHINE:2-56 X 0.188,PNH,STL	TK0435	5549-418
-92	210-0001-00			4	..WASHER,LOCK:#2 INTL,0.013 THK,STL	77900	1202-00-00-0541C
-93	210-0259-00			1	..TERMINAL,LUG:0.099 ID,LOCKING,BRS CD PL	80009	210-0259-00
-94	210-0405-00	B010100	B049999	5	..NUT,PLAIN,HEX:2-56 X 0.188,BRS CD PL	73743	12157-50
	220-0636-00	B050000		5	..NUT,PLAIN,HEX:2-56 X 0.188 HEX,BRS CD PL	73743	ORDER BY DESCR
	131-1219-00	B050000		1	..CONTACT,ELEC:GROUNDING,CU BE	80009	131-1219-00
					..(END ATTACHING PARTS)		
	334-3448-00	B066640		1	..MARKER,IDENT:MARKED NOTICE	07416	ORDER BY DESCR
-95	354-0219-00			2	..RING,RETAINING:EXT,CRESCENT,U/O 0.25 DIA	79136	5103-25-S-ZD-R
-96	401-0057-00			2	..BEARING,CAM SW:FRONT W/0.83 DIA BSHG	80009	401-0057-00
-97	214-1127-00			2	..ROLLER,DETENT:0.125 DIA X 0.125,SST	80009	214-1127-00
-98	214-1139-00			1	..SPRING,FLAT:0.885 X 0.156 CU BE GLD CLR	80009	214-1139-00
					..(REPLACE WITH SAME COLOR CODE AS THE		
					..ORIGINAL PART IN YOUR INSTRUMENT)		
	214-1139-02			1	..SPRING,FLAT:0.885 X 0.156 CU BE GRN CLR	80009	214-1139-02
					..(REPLACE WITH SAME COLOR CODE AS THE		
					..ORIGINAL PART IN YOUR INSTRUMENT)		
	214-1139-03			1	..SPRING,FLAT:0.885 X 0.156 CU BE RED CLR	80009	214-1139-03
					..(REPLACE WITH SAME COLOR CODE AS THE		
					..ORIGINAL PART IN YOUR INSTRUMENT)		
-99	210-0406-00			8	..NUT,PLAIN,HEX:4-40 X 0.188,BRS CD PL	73743	12161-50
-100	407-0653-00			1	..BRACKET,COVER:CAM SWITCH,DELRIN	80009	407-0653-00
-101	105-0275-00			1	..ACTUATOR,CAM SW:TIME/DIV,FRONT	80009	105-0275-00
-102	401-0055-00			1	..BEARING,CAM SW:CENTER,0.83 DIA CAM	80009	401-0055-00
-103	105-0274-00			1	..ACTUATOR,CAM SW:TIME/DIV,REAR	80009	105-0274-00
					..(ATTACHING PARTS FOR ACTR ASSY)		
-104	211-0116-00			8	.SCR,ASSEM WSHR:4-40 X 0.312,PNH,BRS,POZ	77900	ORDER BY DESCR
					.(END ATTACHING PARTS)		
					(ATTACHING PARTS FOR CKT BD)		
-105	213-0146-00			4	SCREW,TPG,TF:6-20 X 0.312,TYPE B,PNH,STL	83385	ORDER BY DESCR
					(END ATTACHING PARTS)		
-106	426-0725-00			1	FR SECT,PLUG-IN:TOP	80009	426-0725-00
-107	426-0724-00			1	FR SECT,PLUG-IN:BOTTOM	80009	426-0724-00
-108	175-0825-00			AR	CABLE,SP,ELEC:2,26 AWG,STRD,PVC JKT,RBN	80009	175-0825-00
-109	175-0827-00			AR	CABLE,SP,ELEC:4,26 AWG,STRD,PVC JKT,RBN	08261	111-2699-954
					STANDARD ACCESSORIES		
	070-1141-00			1	MANUAL,TECH:INSTR	80009	070-1141-00

FIG. 1 EXPLODED



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MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.