

TEKTRONIX®

**SW503
SWEEP
GENERATOR**

INSTRUCTION MANUAL

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Figure 1-1. SW 503 RF Sweep Generator.

SW 503

DESCRIPTION

1.1 INTRODUCTION

The SW 503 is a TM 500-Series plug-in that provides a swept frequency of 1 MHz to 400 MHz with variable sweep rate, width, and output level. Crystal-controlled harmonic oscillators provide comb markers with 1 MHz, 10 MHz, or 50 MHz separation. When used with a DC 502 Option 7 Digital Counter, a frequency marker dot can be positioned anywhere within the frequency range of the SW 503 generator, and the frequency of the marker can be read directly on the counter. In the MANUAL sweep and CW modes, the continuous wave output of the generator can be read to the counter accuracy.

Access jacks on the front panel permit external signals to control or modulate the output amplitude and frequency, and to initiate a sweep.

The SW 503 has a 50 Ω output impedance; the SW 503 Option 1 has a 75 Ω output impedance.

1.2 ELECTRICAL CHARACTERISTICS

The following characteristics apply when the SW 503, in combination with a TM 500-Series power module, is operating within an ambient temperature of 0°C to +50°C, after a 30 minute or more warmup period.

NOTE

The instrument must be calibrated at an ambient temperature between +20°C and +30°C.

Center Frequency

Range: 1 MHz to 400 MHz or more.

Dial Accuracy: Within 8 MHz (readout accuracy can be increased by using the crystal markers or comb, or the dot marker when the SW 503 is used with a DC 502 Option 7 Digital Counter).

Drift: ≤ 100 kHz/5 minutes and ≤ 2 MHz/8 hours after a 30-minute warmup at a constant ambient temperature; a 5-minute stabilization period is required after the center frequency is changed.

Frequency Sweep

Maximum Width: Selectable; 400 MHz (+10% - 0%)
100 MHz ($\pm 15\%$), or 10 MHz ($\pm 15\%$).

Variable: Permits reducing sweep width from maximum down to approximately 200 kHz (when in 10 MHz maximum width position)

Display Linearity (VAR fully clockwise):

400 MHz position: 2%

100 MHz position: 3%

10 MHz position: 3%

Signal Purity

Residual FM: 10 kHz p-p or less in cw position.

Harmonic Related Spuri: Down 30 dB or more from 10 MHz to 400 MHz; 20 dB or more from 3 MHz to 10 MHz; and 15 dB or more from 1 MHz to 3 MHz.

Non-Harmonic Related Spuri: Down 40 dB or more from 1 MHz to 400 MHz fundamental frequency range.

Output Level

RF OUT: Maximum output is approximately 0.7 V rms. This corresponds to +10 dBm ± 0.5 dB into 50 Ω , or +57 dBmV ± 0.5 dB into 75 Ω (Option 1).

Output level can be attenuated 50 dB in 10 dB steps, and 20 dB by a variable attenuator. This provides a range from +10 dBm to -60 dBm for the SW 503, or +57 dBmV to -13 dBmV for SW 503 Option 1.

Step Attenuator Absolute Accuracy (with respect to zero attenuation): ± 0.2 dB/10 dB to a maximum of ± 1.0 dB.

Description—SW 503

CAL (variable attenuator): Continuously variable to 20 dB minimum.

Flatness: Within 0.5 dB peak-to-peak over the frequency range. Flatness is measured with the AUX RF output terminated into 50 Ω , at maximum output, and with detector (optional accessory), and includes harmonics.

AUX RF output: -2 dBm minimum into 50 Ω termination (same for Option 1).

Sweep Times: 10, 1, 0.1, and 0.01 seconds per sweep, $\pm 5\%$, in decade steps. Variable control slows each step by a factor of at least ten from its calibrated position.

Horizontal Output

From -250 mV to +250 mV (500 mV p-p $\pm 5\%$) with an output impedance of 1 k Ω . An internal resistor can be removed to change the output to approximately 10 V peak-to-peak with an impedance of 20 k Ω . (See Subsection 5.1 for instructions.)

BLANKING

Output is blanked during sweep retrace. Blanking is removed for manual and cw operation.

Frequency Markers (Harmonic Comb)

Crystal-controlled harmonic markers with 1 MHz, 10 MHz, or 50 MHz separation. Marker width is adjustable with the MAX SWEEP WIDTH VARIABLE control from about 400 kHz to 50 kHz and the marker amplitude is adjustable with the SIZE control from about 1 mV to 1 V peak-to-peak. If desired, an internal switch will remove the negative portion of the marker for use with an X-Y recorder. Marker size is about 0.5 V.

Marker Accuracy: 0.005% of marker selected.

Dot Marker

Functional only when DC 502 Option 7 Digital Counter is used with the SW 503. The dot marker can be adjusted over the frequency span of the display; accuracy of the dot frequency is relative to the display resolution and the counter accuracy. The sweep is interrupted at the dot position, a count is made, then the sweep continues.

Sweep Mode/Time

Modes: CW, manual, timed sweep, line triggered. When in one of the timed sweep speeds, the sweep is either free-running, or can be triggered by a front-panel button or an externally-applied pulse or switch closure.

External Frequency Control

The full frequency range can be controlled or modulated at rates to 4 kHz. Modulation sensitivity is approximately 50 MHz/volt. With reduced deviation and linearity, modulation rates to 100 kHz are possible. Input impedance is 10 k Ω .

External Amplitude Control

90% modulation can be obtained at modulation frequencies up to 25 kHz; the output level must be reduced 6 dB or more by the variable attenuation control. Sensitivity is about 1 V peak-to-peak per 10% of amplitude modulation. Input impedance is 10 k Ω .

1.3 ENVIRONMENTAL CHARACTERISTICS

Temperature Range:

Operating Range: 0°C to +50°C.

Non-Operating: -40°C to +75°C.

Ambient Temperature During Calibration: +20°C to +30°C.

Altitude Range:

Operating Range: To 15,000 feet.

Non-Operating: To 50,000 feet.

OPERATION

2.1 FRONT-PANEL CONTROLS AND CONNECTORS

Refer to Figure 2-1 for locations.

1 SWEEP MODE/TIME

This switch selects CW, MANual, a timed sweep, or LINE synchronized sweep.

CW position: The SW 503 produces a cw output whose frequency is dependent upon the CTR FREQ control setting (and EXT CONTROL, see 17).

MAN position: The SW 503 provides an output whose frequency is dependent upon the CTR FREQ setting, and the setting of the VAR control (also the settings of the MAX SWEEP WIDTH controls, see 8 and 9).

Timed sweep positions: The timed sweep positions are 10, 1, 0.1, and 0.01 seconds per sweep (when the VAR control is set to its fully clockwise position).

LINE position: In the LINE synchronized mode, the variable and single sweep controls have no effect.

2 VAR

When a timed position is selected, the VAR control can be used to slow the sweep by a factor of about ten from its calibrated setting. A timed sweep is recurrent but can be manually or externally triggered by pulling the VAR control out (see 3 and 17).

3 TRIG

This pushbutton triggers the sweep when the VAR control is pulled out (single sweep position) and the SWEEP TIME/MODE switch is in one of the timed sweep positions.

4 MARKERS

These pushbuttons select crystal-controlled harmonic (comb) markers with frequency spacings of 1 MHz, 10 MHz, or 50 MHz. The markers are applied to the SCOPE VERT connector and are mixed with the detected input from the device under test.

NOTE

An internal switch removes the negative-going portion of the markers, which is often desirable when using the SW 503 with an X-Y recorder. See Subsection 2.2.10.

5 MARKERS SIZE

This control varies the amplitude of the comb markers from about 1 mV to 1 V peak-to-peak.

6 DOT POSITION

When the SW 503 is used with a frequency counter with sweep stop logic such as the DC 502 Option 7, this control positions an intensified frequency marker dot anywhere on the display. The frequency of the dot position is then read out on the DC 502 with digital counter accuracy. See Subsection 2.2.9.

7 CTR FREQ (Center Frequency)

This multiturn control selects the center frequency of the RF OUT signal.

NOTE

It is necessary to correlate the setting of the CTR FREQ and MAX SWEEP WIDTH controls to avoid "wrapping around" zero frequency.

8 MAX SWEEP WIDTH

Three pushbuttons select maximum sweep widths of 10 MHz, 100 MHz, or 400 MHz.

9 VARIABLE (MAX SWEEP WIDTH)

The VARIABLE sweep width control reduces the width from the maximum selected sweep.

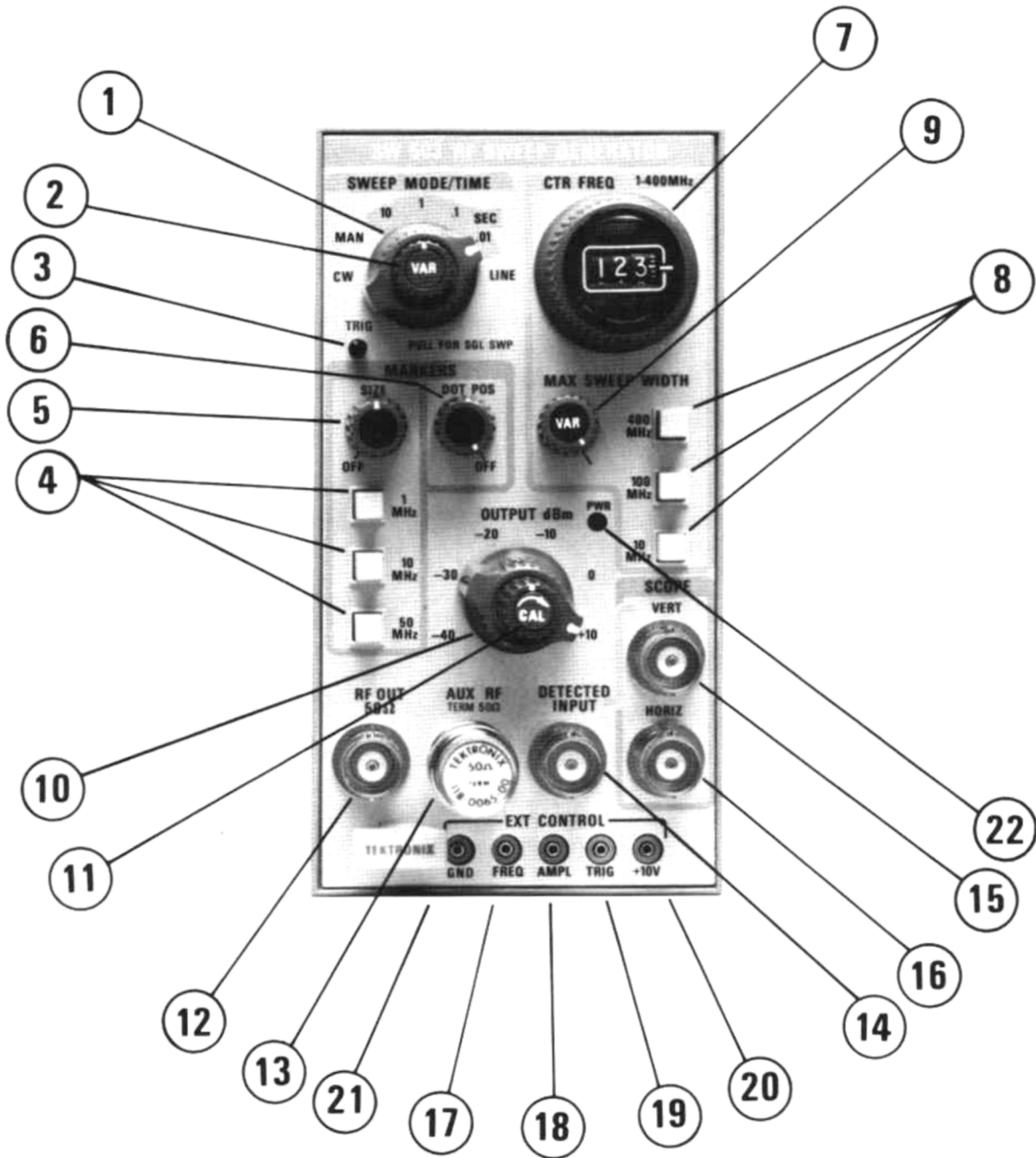


Figure 2-1. SW 503 front panel.

10 OUTPUT dBm (SW 503) or ATTENUATION dB (SW 503 Option 1)

SW 503: This six-step control selects the rf output in 10-dB steps from +10 dBm to -40 dBm.

SW 503 Option 1: This six-step control selects the rf attenuation in 10-dB steps from 0 dB to 50 dB. Maximum output levels are from +57 dBmV to +7 dBmV.

The output is calibrated as indicated when the CAL control (see 11) is in its fully clockwise position.

11 CAL (VARIABLE ATTENUATION)

The CAL control adjusts the RF OUT level to at least 20 dB below the level indicated by the step attenuator.

12 RF OUT

This connector provides a sweeping rf output signal, at a level selected by the attenuator controls. The source impedance is 50 Ω (SW 503) or 75 Ω (SW 503 Option 1).

13 AUX RF TERM 50 Ω

This connector provides a sweeping rf signal, for use with a frequency counter or other instrument. The output level is at least -2 dBm and is independent of attenuator settings. The source impedance is 50 Ω .

14 DETECTED INPUT

This connector allows returning the demodulated rf signal from the device under test (through an external detector if necessary) for the purpose of adding comb frequency markers.

15 SCOPE VERT

This connector is the output for the combined demodulated rf (from DETECTED INPUT) and comb frequency markers. The output is applied to the vertical input of an oscilloscope or display monitor.

16 SCOPE HORIZ

This connector is the output for the sweeping voltage that is provided for application to the horizontal input of an oscilloscope or display monitor. Nominal output amplitude is 500 mV p-p; an internal wiring change will provide 10 V p-p (See Subsection 5.1).

EXT CONTROL**17 FREQ**

This input allows an external signal to frequency modulate or control the output signal. Refer to Electrical Characteristics, Subsection 1.2, for signal requirements. Note that, when used with the SWEEP MODE/TIME switch in the MANUAL position, the external control is not dependent upon the settings of the MAX SWEEP WIDTH controls, whereas the manual sweep control is dependent.

18 AMPL

This input allows an external signal to amplitude modulate or control the output signal. Note that for maximum usefulness, the output amplitude must be reduced 6 dB or more by the VARIABLE attenuation control. Refer to Electrical Characteristics, Subsection 1.2, for signal requirements.

19 TRIG

When the VAR control is in the single sweep position (PULL for SINGLE SWEEP), this input allows an external signal to trigger the sweep. The applied signal can be a positive-going pulse of up to 10 V amplitude and at least 1 μ s duration, or can be supplied by a switch closure (solid state or mechanical) to the +10 V connector or similar source.

20 +10 V

This connector provides a convenient +10 V source to facilitate using the above-mentioned external controls.

21 GND (Ground)

This connector is connected to ground on the circuit board, to facilitate using the above-mentioned external controls, or for other signal ground purposes. DO NOT use this connector for safety earth.

22 PWR (Power)

This indicator lamp shows when power is applied to the instrument.

Operation—SW 503

2.2 OPERATING INSTRUCTIONS AND NOTES

2.2.1 General Setup and First-Time Operation

Install the SW 503 in a TM 500-Series power supply, then apply power to the unit, and allow instruments to warm up.

Connect the SW 503 Sweep Generator, the device under test, and the oscilloscope as shown in Figure 2-2. Refer to the following sections for details and special considerations.

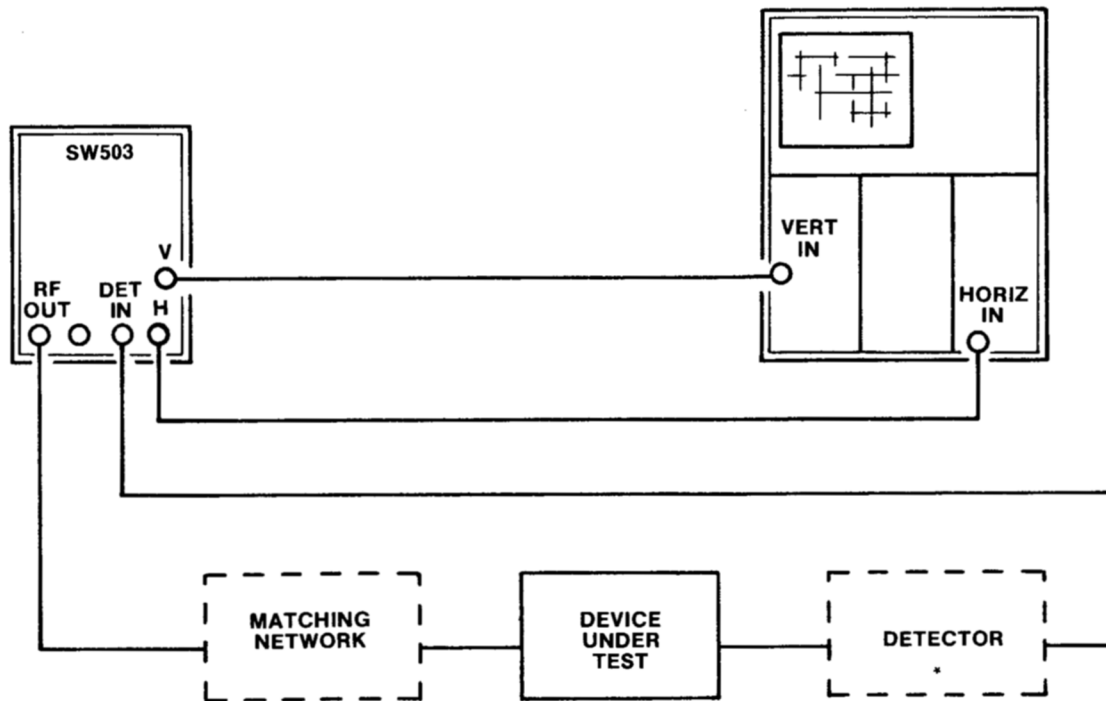
After completing the setup, adjust the SW 503 controls for the required center frequency, sweep width, and output amplitude. If desired, turn the markers on and adjust their amplitude. For first-time operation, set the controls as follows:

| | |
|---|------------------------------------|
| CTR FREQ | 200 MHz |
| MARKERS SIZE | midrange |
| MARKERS frequency | 50 MHz |
| MAX SWEEP WIDTH | 400 MHz |
| VAR (max sweep width) | fully clockwise |
| OUTPUT dBm (SW 503) or ATTENUATION dB (SW 503 Option 1) | Maximum (fully clockwise) position |
| CAL (output) | fully clockwise |

Connect the RF OUT through a detector to the DETECTED INPUT. Adjust the oscilloscope or display monitor vertical and horizontal sensitivities for an on-screen display. Vary each of the above controls and note its effect on the the display.

| | |
|-----------------|-----------------|
| SWEEP MODE/TIME | .01 s |
| VAR | fully clockwise |

A full specification check for the SW 503 is included in the Calibration Procedure, Subsection 3.4. Refer, however, to the warning page preceding Section 3.



* if necessary—see text

Figure 2-2. Typical operating setup.

2.2.2 Cable Connections

Since hum, rf leakage, spurious signal pickup, and standing waves must be kept to a minimum, it is essential that good connections be maintained throughout the entire setup. Use coaxial cables with bnc connectors wherever possible. The RF OUT cable especially should be kept as short as practical, and its impedance should match the output impedance of the SW 503. An idea of the integrity of the cabling can be obtained by connecting the detector, through the cables, directly to the rf output source, bypassing the device under test.

2.2.3 Impedance Matching

If the input impedance of the device under test is not the same as the sweep generator output impedance, a matching network should be used to ensure that a constant amplitude versus frequency is sent to the device under test. This matching network can be either resistive or inductive; the resistive matching pad is simpler to construct than the balun type transformer, but it provides more insertion loss. Figure 2-3 shows schematics for several resistive matching pads. Note that the leads connecting the 300 Ω output from the pad to the device under test should be as short as possible, preferably less than one inch.

2.2.4 Detecting (Demodulating)

After the sweep generator signal passes through the rf circuit of the device under test, it must be demodulated before being connected to the DETECTED INPUT connector of the generator. If a demodulator is not a part of the device under test, one must be added externally. The input impedance of the demodulator must present the proper load to the device under test. Refer to Optional Accessories for recommended units, or see Figure 2-4 for the basic schematic of a detector.

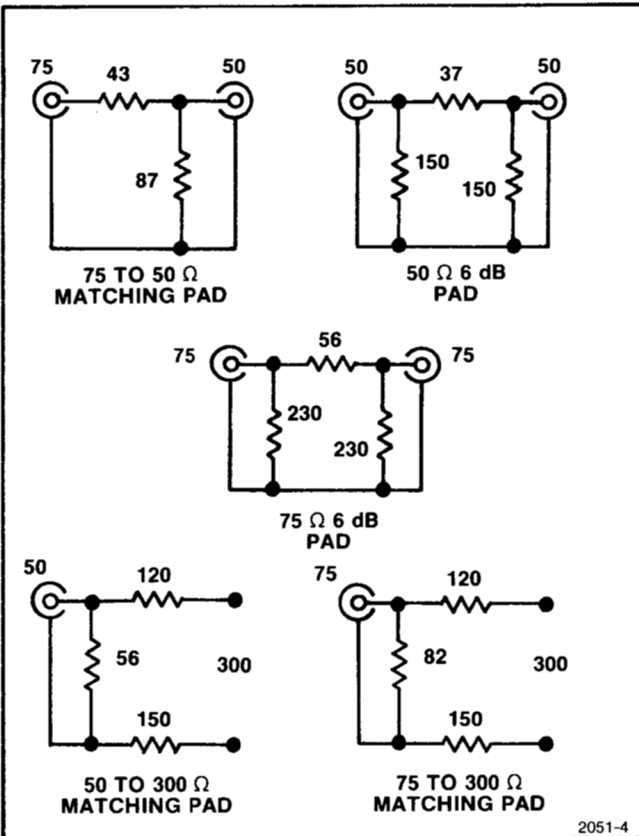


Figure 2-3. Typical resistive pads.

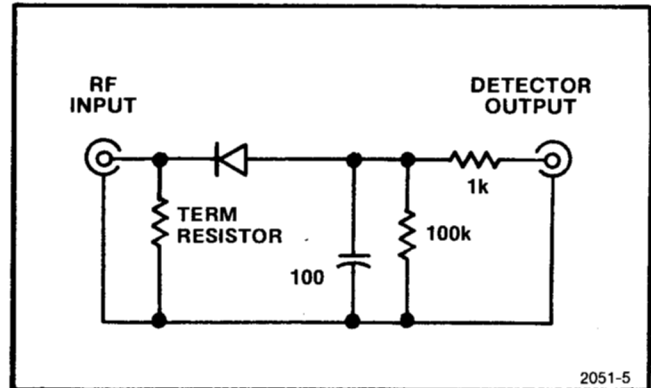


Figure 2-4. Basic detector schematic diagram.

Operation—SW 503

2.2.5 Sweep Rate Effects

When sweeping rf circuits having rapid amplitude changes, errors may occur, due mainly to detector delays. Decreasing the detector output time constant will minimize this effect. Figure 2-5 illustrates sweep rate effect.

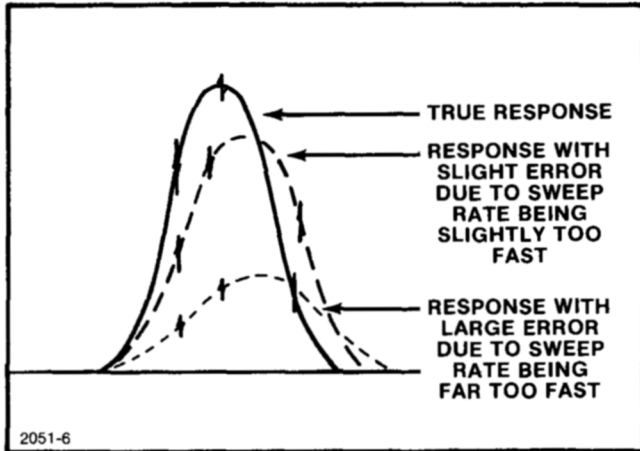


Figure 2-5. Errors from sweep rate effects.

To check for sweep rate effect, first set the sweep width to its lowest practical amount, then increase sweep time while closely observing the swept output response. Any change in the response indicates the sweep rate is too fast for a true response. When a further increase of sweep time does not change the response, a true response has been obtained.

2.2.6 Overloading Effects

The use of excessive input signals to the device under test can cause overloading. To assure that this condition is not present, and that the response is a true representation of the device under test, turn the OUTPUT dBm (ATTENUATION dB on SW 503 Option 1) and CAL controls to minimize output amplitude. Gradually increase the output amplitude until a response is obtained. Further increase of the output amplitude should not change the configuration of the response envelope except in amplitude. If the response envelope does change, such as flattening at the top, decrease the output just far enough to restore the proper configuration.

2.2.7 Low-Level Measurements

When making measurements at low levels, the effects of radiation and ground loops may become problems. Using double-shielded cables for rf signals helps minimize the radiation problem. Ground loops causing hum pickup can sometimes be eliminated by completing only one ground connection between each instrument. This applies particularly to the oscilloscope horizontal input. If the ground connection is made at the vertical input terminal, an additional ground at the horizontal input terminal will often result in hum pickup.

Measurement sensitivity will be determined by the type of detector used.

2.2.8 TV Receiver Interference

When using the SW 503 with a tv receiver, interference from the receiver's horizontal sweep circuit may appear on the response curve, making it difficult to observe a clearly-defined trace. Therefore, we recommend that the tv sweep circuit be disabled during testing.

2.2.9 Use With Digital Counter

The DOT POS control on the SW 503 functions only when a digital counter with sweep interrupt logic, such as the DC 502 Option 7, is used with the system. In use, the SW 503 sweep generating voltage is interrupted at the dot position (positionable with the DOT POS control), and the counter is told to initiate a count. At the conclusion of the counter gate time, the sweep is resumed. The counter provides an accurate indication of the SW 503 frequency at the dot location; the dot is actually caused by the sweep remaining stationary during the count.

In order for the DC 502 Option 7 to work properly, both units must be installed in specific compartments in a TM 500-Series power module equipped with Option 7. This option adds the wires necessary to interface the two units via their rear-panel connectors. See Subsection 5.2 for further information (also see warning page preceding Section 3).

2.2.10 Operation With X-Y Plotters

An internal switch (S510) in the SW 503 facilitates operation with X-Y plotters. This switch is located on the marker selection assembly directly behind the RF OUT connector (see Figure 2-6).

For normal operation, the switch is set toward the front panel. For plotter operation, with the switch set toward the rear of the instrument, the high-frequency marker signals are converted to a lower frequency (rectified) which is compatible with the operating speed of the plotter pen or stylus.

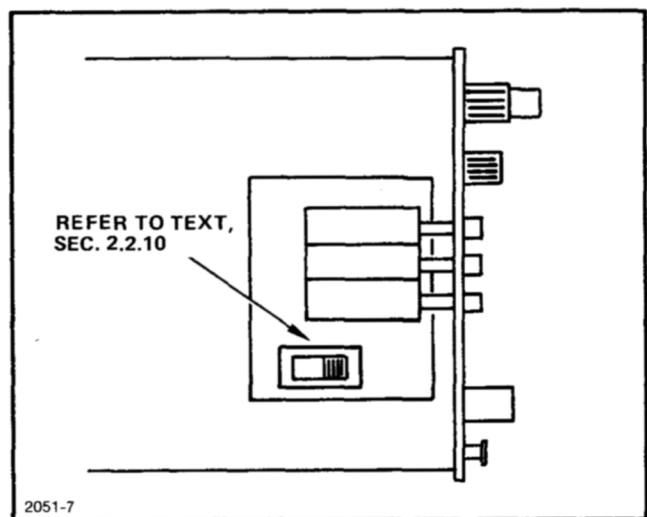


Figure 2-6. Markers selection switch location.

2.3 EXTERNAL CONTROL

Frequency, amplitude, and sweep initiation can be externally controlled through the use of the front panel mini-pin jack connectors. These features can be used singly or in any combination.

Functions of the front panel external control connectors can be duplicated through the rear plug-in connector by adding appropriate wires; instructions to do this are located in Subsection 5.2 (also see warning page preceding Section 3).

2.3.1 Frequency Control

External frequency control may be achieved by applying a voltage between 0 V and +10 V to the FREQ jack (refer to Electrical Characteristics, Subsection 1.2, for complete signal characteristics.). For example, connect a 10 k Ω potentiometer to the +10 V, GND, and FREQ jacks as shown in Figure 2-7.

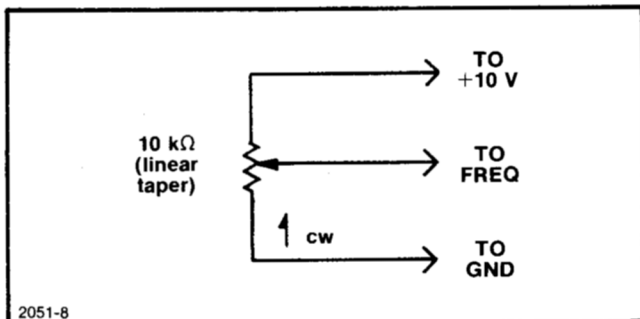


Figure 2-7. External control of frequency.

To frequency modulate the output, connect a source of suitable voltage range and adjustable amplitude between the GND and FREQ jacks.

Remote frequency adjustment or modulation is possible in any mode, although the most practical application is with the MANual or CW modes. The input to the FREQ jack is summed with the SWEEP WIDTH selection and the CTR FREQ selection (see Schematic Diagram); therefore, these settings interact.

NOTE

The greatest effect of a remotely-applied signal is realized when the SWEEP MODE/TIME switch is in the MANual position, the VAR (manual sweep) control is fully counterclockwise, the MAX SWEEP WIDTH is set to 400 MHz, its VAR control is fully clockwise, and the CTR FREQ is adjusted for 1 MHz.

2.3.2 Amplitude Control

External amplitude control may be achieved in a similar manner to frequency control (refer to Electrical Characteristics, Subsection 1.2, for complete signal characteristics). For example, to remotely adjust the amplitude, connect a 10 k Ω potentiometer to the +10 V, GND, and AMPL jacks as shown in Figure 2-8.

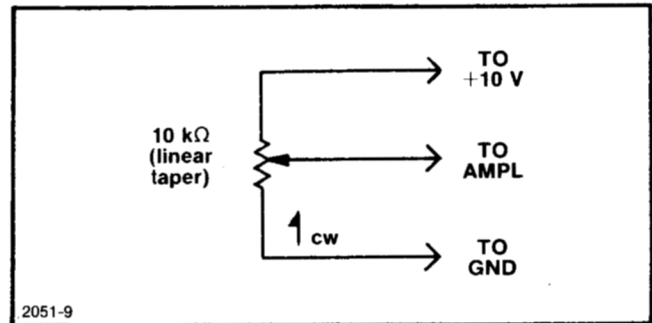


Figure 2-8. External control of amplitude.

To amplitude modulate the output, connect a source of suitable voltage range and adjustable amplitude between the GND and AMPL jacks.

The most practical application of external amplitude control is with the MANual or CW modes. When the CAL control is in its calibrated position (fully clockwise), applying +10 V will increase the amplitude approximately 5 dB, regardless of the step attenuator setting. When the CAL control is in its fully counterclockwise position (gain reduced about 20 dB), applying +10 V will increase the gain approximately 10 dB.

2.3.3 Trigger Control

When the SWEEP MODE/TIME switch is in the 10, 1, 0.1, or 0.01 s sweep modes and the VARIable control is pulled out for single sweep, a sweep may be initiated by applying a voltage of between about +2 V and +10 V to the TRIG jack. Two methods to accomplish this are:

- a) Making a switch closure between the TRIG and +10 V jacks;
- b) Applying a +10 V pulse between the TRIG and GND jacks. The pulse duration should be at least 1 μ s.

The repetition rate of the applied signal must be slower than the sum of the sweep plus recovery times.

CALIBRATION

3.1 INTRODUCTION

To ensure maximum performance, the instrument should be checked after each 1000 hours of operation or every six months, whichever occurs first. It should also be checked whenever repairs have been made.

This section provides check and adjustment information for calibrating the instrument to its specification. We advise checking the performance, and recalibrating only those circuits that do not meet the specification.

In general, adjustments must be performed in the sequence given, and while the instrument is operating at an ambient temperature of +20°C to +30°C after a 30-minute warmup period.

3.2 EQUIPMENT REQUIRED

| TYPE | MINIMUM PERFORMANCE REQUIREMENTS | EXAMPLES |
|--|--|----------------------------|
| Power Module | | Tektronix TM 500-Series |
| Plug-in extender cable | | Tektronix 067-0645-01 |
| Display oscilloscope ¹ | X-axis, 50 mV/div; Y-axis, 200 mV/div. | Tektronix SC 502 |
| Test oscilloscope ¹ | Vertical sensitivity, 0.1 V/div; sweep speeds 1 ms/div to 5 s/div. Triggered time base, 3% accuracy. | Tektronix 5000-Series |
| Detector (SW 503) | 50Ω input; ±0.3 dB from 1 MHz to 400 MHz. | Tektronix 118-0070-00 |
| Detector (SW 503 Option 1) | 75 Ω input; ±0.3 dB from 1 MHz to 400 MHz. | Tektronix 118-0071-00 |
| Power meter | -10 and +10 dBm ±0.5 dB. | Hewlett-Packard 435A |
| 75 Ω to 50 Ω minimum loss pad (For Option 1 only.) | | Tektronix 011-0112-00 |
| Spectrum analyzer | 1 MHz to 400 MHz coverage. | Tektronix 7L12 or 7L13 |
| Digital voltmeter | 0.1% dc voltage accuracy. | Tektronix DC 501 or DC 502 |

¹Although spoken of as separate instruments in the procedure, these may be the same instrument.

3.3 Preliminary Steps

WARNING

The following procedure exposes the technician to a maximum potential of about 67 V dc (± 33.5 V from ground). Take appropriate safety precautions. Refer also to Safety Notice page at the beginning of this section.

Remove the SW 503 Plug-In from the mainframe, remove its side covers, and reconnect it to the mainframe via the plug-in extender cable.

Turn the system power on and allow the units to warm up for 30 minutes or more.

3.4 PROCEDURE

1. Check/Adjust Power Supplies

a. Connect the digital voltmeter between ground and pin 2 of the Sweep Oscillator Module A20 (locate in Figure 3-1).

b. Adjust R310 (+18; locate in Figure 3-4) for a reading of +18.00 V.

c. Connect the digital voltmeter between ground and pin 3 of Sweep Oscillator Module A20 (locate in Figure 3-1), and check for a reading of -18.00 V ± 0.2 V.

d. Connect the digital voltmeter between ground and the front panel +10 V jack, and check for a reading of $+9.8$ V ± 0.2 V.

e. Connect the digital voltmeter between ground and pin 3 of Marker Module A10 (locate in Figure 3-1), and check for a reading of $+5$ V ± 0.2 V.

2. Adjust Sweep Generator

a. Set the SWEEP MODE/TIME control to 0.01 s, and the VAR control fully clockwise.

b. Connect the SW 503 SCOPE HORIZ to the test oscilloscope vertical input. Adjust the test oscilloscope vertical sensitivity to 0.1 V/div² and time base to 5 ms/div, and adjust triggering and positioning for a stable pattern similar to Figure 3-2.

c. Adjust R405 (FREQ) for a sweep time (positive-going portion of waveform) of 10 ms, as indicated in Figure 3-2. See Figure 3-3 for adjustment location.

²SW 503 sweep voltage output (SCOPE HORIZ) is normally 500 mV p-p; however, instruments have provision for changing the sweep voltage to 10 V p-p (see Subsection 5.1).

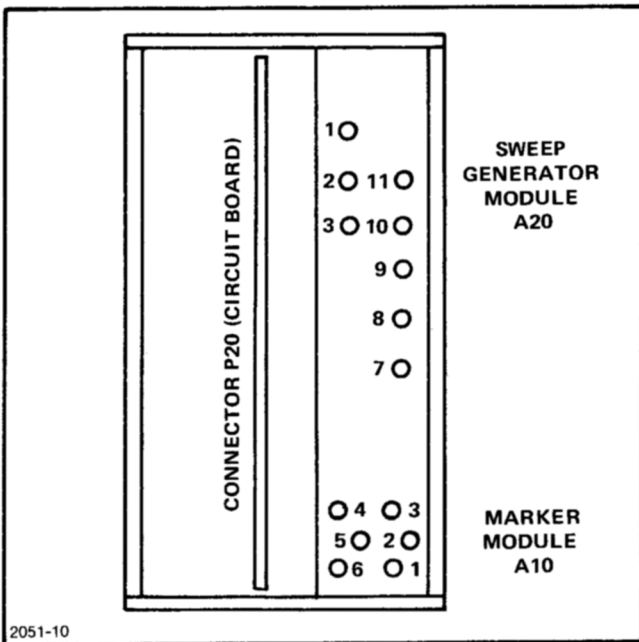


Figure 3-1. SW 503 rear view.

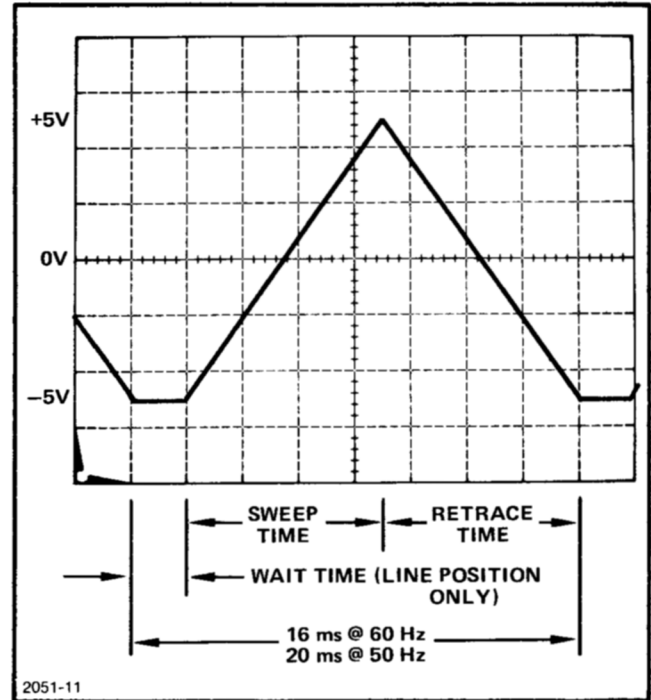


Figure 3-2. SCOPE HORIZ waveform as seen on test oscilloscope.

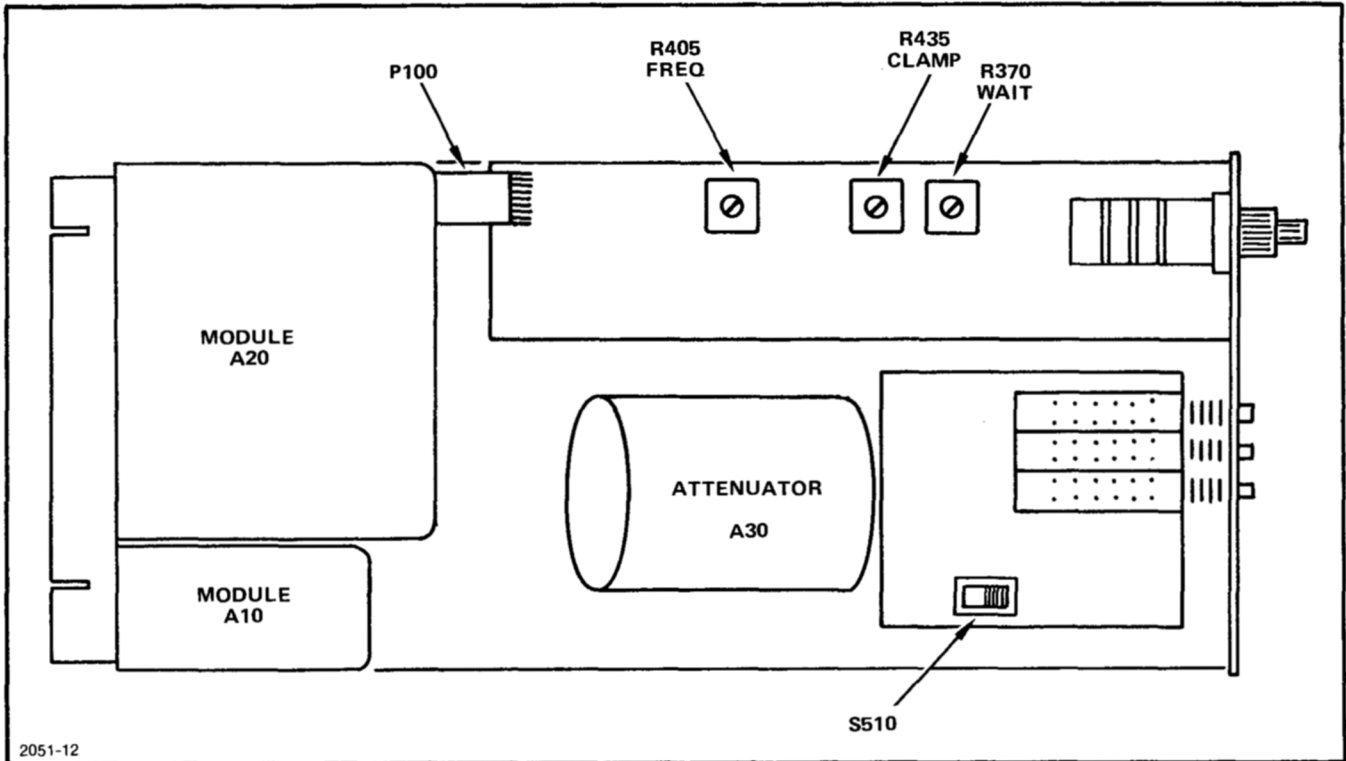


Figure 3-3. SW 503 adjustment locations, left side.

d. Rotate the VAR control fully counterclockwise. The sweep time should be 100 ms or greater (reduce test oscilloscope sweep time as necessary to check).

e. Return the VAR control to its fully-clockwise position, and set the SWEEP MODE/TIME switch to LINE. Set the test oscilloscope time base to 1 ms/div, and adjust R435 (CLAMP) to clamp the base of the waveform to the same amplitude as the waveform base in step c (Figure 3-2). See Figure 3-3 for adjustment location.

f. Adjust R370 (WAIT) for a wait time of approximately 1 ms as indicated in Figure 3-2. See Figure 3-3 for adjustment location.

3. Adjust Frequency Calibration

a. Set the SWEEP MODE/TIME switch to CW, and the CTR FREQ control to 200 MHz.

b. Connect the digital voltmeter between ground and U210A pin 1 (locate in Figure 3-4).

c. Adjust R185 (BAL) for a voltage of zero on the digital voltmeter. See Figure 3-4 for adjustment location.

d. Connect the SW 503 to the display oscilloscope as indicated in Figure 3-5, and set the controls as follows:

SW503

| | |
|-----------------------------|-----------------|
| SWEEP MODE/TIME | 0.01 s |
| (Sweep Time) VAR | Fully clockwise |
| CTR FREQ | 200 MHz |
| MAX SWEEP WIDTH | 400 MHz |
| VAR (Max sweep width) | Fully clockwise |
| 50 MHz MARKERS | ON (pushed in) |
| MARKER SIZE | Midrange |
| OUTPUT dBm (50 Ω units) | +10 |
| ATTENUATION dB (75 Ω units) | 0 |
| CAL (output dBm) | Fully clockwise |

Display Oscilloscope

| | |
|------------------------|------------------------|
| Mode | X-Y |
| Horizontal sensitivity | 50 mV/div ² |
| Vertical sensitivity | 200 mV/div |

²SW 503 sweep voltage output (SCOPE HORIZ) is normally 500 mV p-p; however, instruments have provision for changing the sweep voltage to 10 V p-p (see Subsection 5.1).

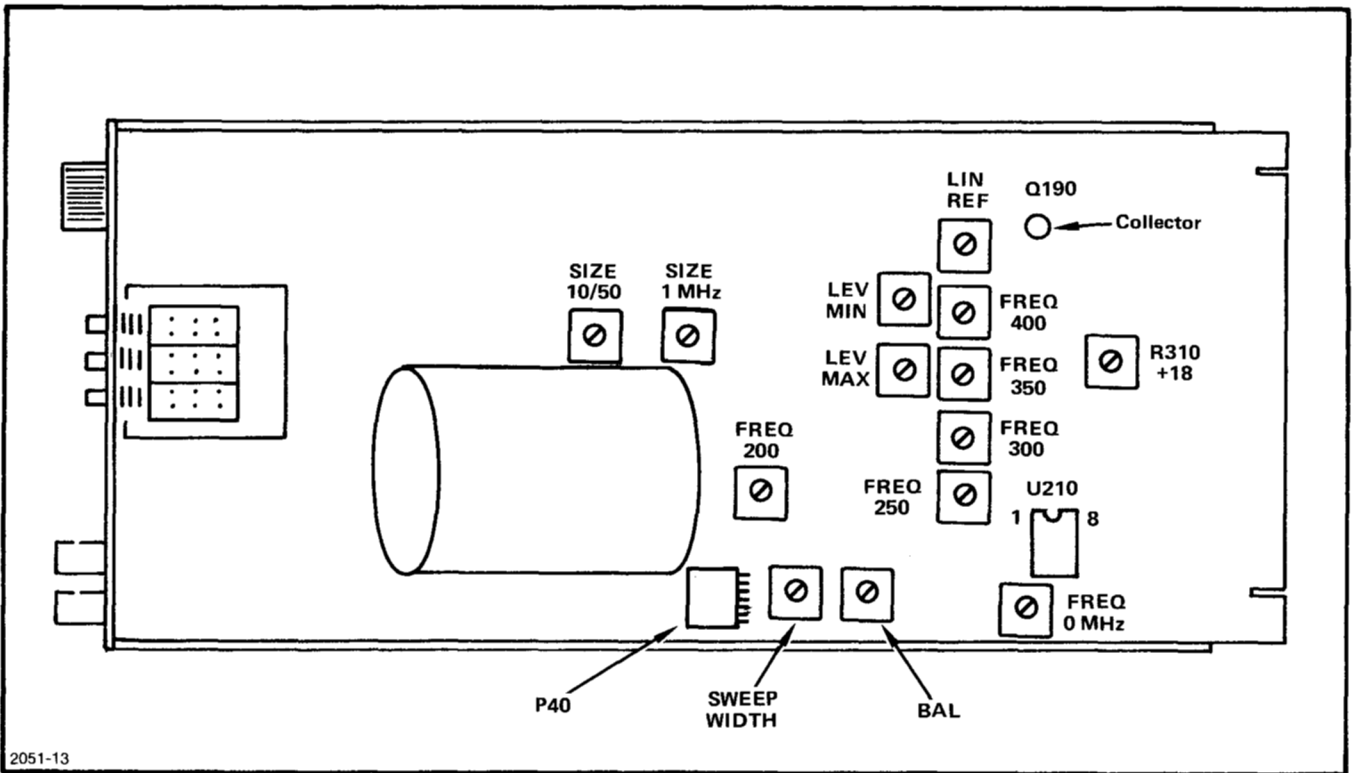


Figure 3-4. SW 503 adjustment and test points locations, right side.

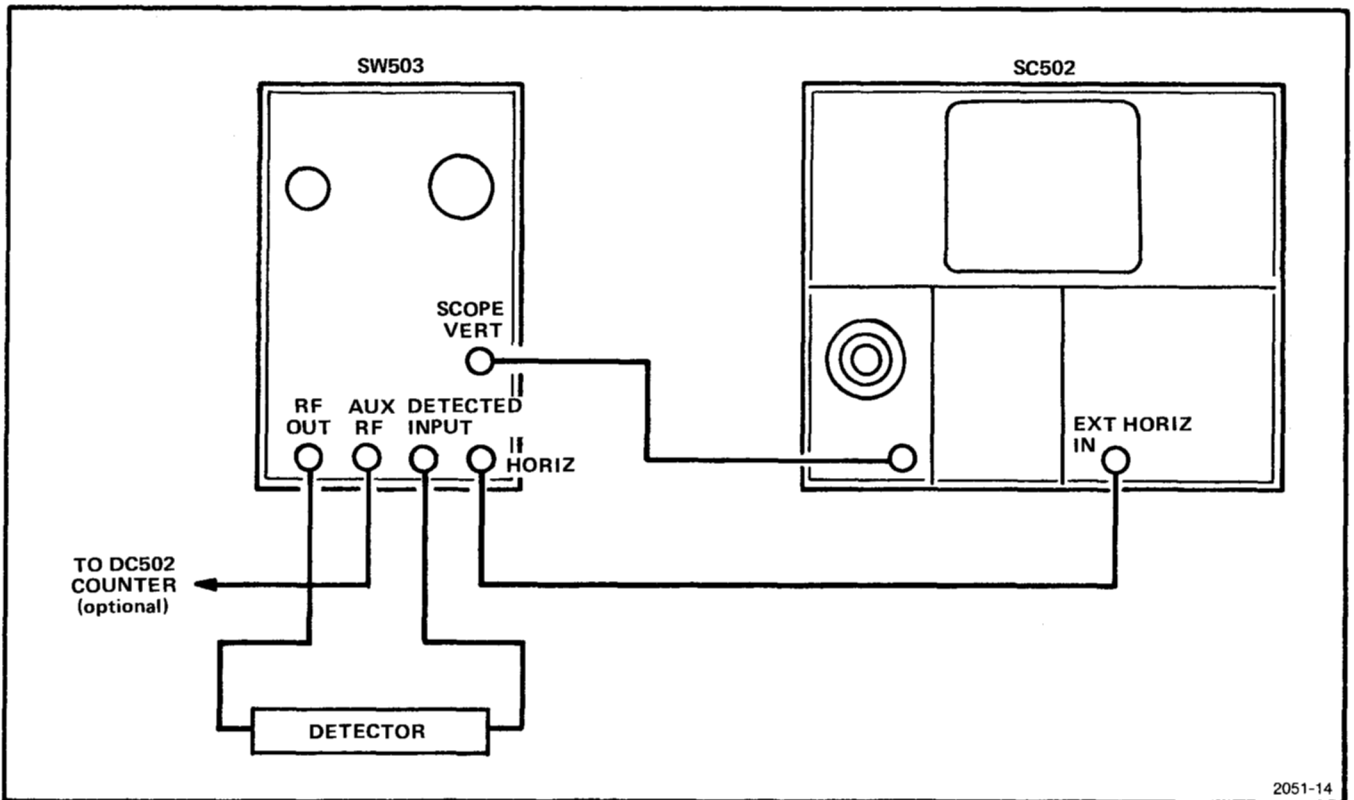


Figure 3-5. Normal interconnections for calibration.

To identify the frequencies shown on the resultant display, the markers must be positively identified. The zero beat in the swept rf output does not vary in amplitude with the MARKERS SIZE control and looks distinctly different than a marker; therefore, it can be used as a frequency reference. The first marker to the right of zero is 50 MHz, the second marker is 100 MHz, and so on. The frequency of each marker can be identified by referring to the zero beat until the CTR FREQ dial reading is sufficiently calibrated.

e. Identify the 200 MHz marker, then reduce the frequency sweep with the MAX SWEEP WIDTH VAR control and adjust R235 (FREQ 200) to place the marker in the center of the oscilloscope display. See Figure 3-4 for adjustment location.

f. Set the CTR FREQ control to 50 MHz and adjust R225 (FREQ 0 MHz) to place the 50 MHz marker at the center of the oscilloscope display. See Figure 3-4 for adjustment location.

g. Reset the CTR FREQ to 200 MHz, and repeat steps e and f until the interaction is minimized.

h. Set the CTR FREQ control to 350 MHz and connect a probe from the test oscilloscope to the junction of Q190 collector and CR196 cathode (locate in Figure 3-4). Adjust the test oscilloscope to display at least one cycle (2 ms/div), and adjust its vertical sensitivity for a full-screen display, dc-coupled (>2 V/div).

i. Momentarily disconnect the probe, or switch the test oscilloscope input to ground, and vertically position the trace to center screen; then reconnect the probe and adjust R195 (LIN REF) to center the displayed waveform voltage to about zero. See Figure 3-4 for adjustment location.

j. Set the CTR FREQ control to 250 MHz, and adjust R215 (FREQ 250) to place the marker at the center of the display. See Figure 3-4 for adjustment location.

k. Set the CTR FREQ to 300 MHz, 350 MHz, and 400 MHz respectively, and adjust the corresponding frequency adjustments (R210, R204, and R201) to place the correct marker at the center of the display. See Figure 3-4 for adjustment locations.

l. Set the CTR FREQ control to 200 MHz, and MAX SWEEP WIDTH controls for 400 MHz (VAR fully clockwise).

m. Adjust R180 (SWEEP WIDTH) so that both the 0 Hz and the 400 MHz markers are just visible at the ends of the sweep. See Figure 3-4 for adjustment location.

4. Check Sweep Width

a. Press the 100 MHz MAX SWEEP WIDTH and 50 MHz MARKERS buttons, and check that the sweep width is at least 100 MHz. (That is, three markers visible. It may be necessary to vary the CTR FREQ slightly.)

b. Press the 10 MHz MAX SWEEP WIDTH and 10 MHz MARKERS buttons, move the CTR FREQ about 5 MHz as necessary, and check that the sweep is at least 10 MHz (that is, two markers visible).

5. Check Frequency Dial Accuracy

a. Press the 400 MHz MAX SWEEP WIDTH and 50 MHz MARKERS buttons.

b. Adjust the CTR FREQ control from 50 MHz to 400 MHz and check that it reads within ± 8 MHz of a multiple of 50 MHz when each marker is centered.

6. Adjust Output Level

a. Adjust the front panel controls as follows:

| | |
|----------------------------------|-----------------|
| CTR FREQ | 100 MHz |
| SWEEP MODE/TIME | CW |
| OUTPUT dBm (50 Ω) | +10 dBm |
| or ATTENUATION dB (75 Ω) | 0 dB |
| CAL (output dBm) | Fully clockwise |

NOTE

For standard instruments with 50 Ω output, perform steps b through e. For Option 1 instruments with 75 Ω output, perform steps f through i.

b. Connect a power meter to the RF OUT connector.

c. Adjust R240 (LEVEL MAX) for an output level of +10 dBm. See Figure 3-4 for adjustment location.

d. Set the CAL control fully counterclockwise, and adjust R245 (LEVEL MIN) for an output level of -10 dBm. See Figure 3-4 for adjustment location.

e. Rotate the CAL control fully clockwise, and repeat steps c and d to minimize interaction.

Calibration—SW 503

f. Connect a power meter (with 50 Ω input) through a 50 Ω to 75 Ω minimum loss attenuator (Tektronix Part Number 011-0112-00) to the RF OUT connector.

g. Adjust R240 (LEVEL MAX) for a power meter indication of +2.5 dBm.

h. Set the CAL control fully counterclockwise, and adjust R245 (LEVEL MIN) for a power meter indication of -17.5 dBm.

i. Rotate the CAL control fully clockwise, and repeat steps g and h to minimize interaction.

7. Check Attenuator Steps

NOTE

There are several ways the attenuator step accuracy could be checked. Steps a through c below outline one method; steps d through e give an alternate method.

a. Set the CAL control fully clockwise and note the power meter reading.

b. Reduce the OUTPUT dBm or ATTENUATION dB control one step and check for a 10 dB reduction on the power meter indication (within ± 0.2 dB per 10 dB steps, maximum of ± 1.0 dB overall).

c. Reset the power meter range as necessary and repeat step b for all attenuator steps. Preferably check both steps of the output attenuator on the same range of the power meter to avoid compounding tolerances.

d. (Alternate Method) Connect the RF OUT through a suitable rf step attenuator or attenuator pads to a detector (which is connected to the DETECTED INPUT).

e. Compare the difference in the output when attenuated by the internal attenuator, to that when attenuated by the external precision attenuator. The difference between the two outputs is the attenuator error. Maximum allowable error is 2%, not including the basic flatness or vernier attenuator error. The detector can be used at levels down to about -40 dBm; at lower levels an rf amplifier or spectrum analyzer must be used.

8. Check Flatness

a. Connect the RF OUT through a detector (optional accessory) to the DETECTED INPUT and set the controls as follows:

| | |
|-------------------------------------|-----------------------|
| SWEEP MODE/TIME | 0.01 s |
| CTR FREQ | 1 MHz |
| MAX SWEEP WIDTH | 10 MHz |
| OUTPUT dBm or ATTENUATION dB | Maximum output |
| CAL (Output dBm) | Fully clockwise |
| Display oscilloscope vertical input | 50 mV/div, dc-coupled |

b. Adjust the display oscilloscope vertical sensitivity for a 10-division display. To accomplish this, since most displays have only eight divisions vertically, first adjust for eight divisions using the display oscilloscope variable attenuator control, then reposition the display (not the baseline) two divisions toward the center, and readjust the variable attenuator for two more divisions amplitude.

c. Adjust the CTR FREQ throughout its range and check that the vertical display remains within 0.6 major division. With the vertical amplitude set as previously shown, this corresponds to 0.5 dB.

9. Check AUX RF Output Level

a. Terminate the RF OUT, connect a power meter to the AUX RF connector, and switch the SWEEP MODE/TIME to CW.

b. Tune the CTR FREQ throughout its range, and check that the AUX RF level is at least -2 dBm.

10. Check Harmonics and Spurious Signals

a. Connect the SW 503 RF OUT to the input of a spectrum analyzer, such as a 7L12 or 7L13.

b. Set the SWEEP TIME/MODE to CW, CTR FREQ to 1 MHz, and output to maximum.

c. Adjust the spectrum analyzer to display the 1 MHz fundamental, with a Span/Div of 100 MHz. Set the Reference Level as low as possible without overdriving, and position the top of the fundamental to a convenient reference line.

d. Vary the CTR FREQ control throughout its range, adjust the spectrum analyzer as necessary, and check that the SW 503 harmonics are at least 15 dB below the fundamental from 1 to 3 MHz, at least 25 below from 3 to 10 MHz, and at least 30 dB below from 10 to 400 MHz. Also check that the non-harmonic spurious signals are at least 40 dB below the fundamental.

11. Adjust Markers Size

a. With the SW 503 connected to the display oscilloscope as in Figure 3-5, set the controls as follows:

| | |
|--------------------------|---------|
| SWEEP MODE/TIME | 0.01 s |
| CTR FREQ | 200 MHz |
| MAX SWEEP WIDTH | 10 MHz |
| OUTPUT dBm (50 Ω) | 0 dBm |
| or ATTENUATION dB (75 Ω) | 10 dB |
| MARKERS | 50 MHz |

b. Center the marker, then adjust the MAX SWEEP WIDTH VAR control until the marker is about one division wide.

c. Adjust the display oscilloscope vertical sensitivity to about 50 mV/div, then adjust the MARKERS SIZE control for a nearly full screen amplitude.

d. Push the 1 MHz MARKERS button and adjust R120 (SIZE 1 MHz) to obtain a saturated marker on the oscilloscope display, with no spurious markers. A saturated marker is obtained when a further increase in size does not increase the marker amplitude on the display (it may be necessary to readjust the MARKERS SIZE to keep the marker on the screen). Increasing the adjustment beyond this point results in spurious markers.

e. Press the 50 MHz MARKERS button and adjust R130 (SIZE 10/50) for the same amplitude display as in step d.

This completes the calibration procedure.

CIRCUIT DESCRIPTION

4.1 GENERAL

Refer to the block diagram in Section 8 during the following discussion. There are four basic circuitry functions in the SW 503: (1) generating the sweep ramp voltage; (2) generating the rf output; (3) generating frequency markers; and (4) interfacing the unit to a frequency counter.

The sweep ramp generator circuit generates a triangular waveform that rises at the desired sweep speed. This ramp is applied to the sweep drive circuit, which sweeps the rf oscillator, and to the horizontal output, which is used to sweep the display oscilloscope.

The ramp is applied to the rf sweep oscillator, which produces an rf output. As the ramp voltage rises, the rf signal sweeps higher in frequency and the display oscilloscope trace moves to the right. As the ramp falls, the display retraces and the rf oscillator is turned off, providing a baseline. The frequency is determined by the instantaneous voltage level of the sweep drive ramp. If the ramp is stopped (dc output), the rf is a continuous wave. Varying the characteristics of the ramp by using the CTR FREQ and MAX SWEEP WIDTH controls provides control of the center frequency and the frequency range through which the unit sweeps.

The leveler compares a rectified rf output to a dc reference voltage. Any error between the two is amplified and sent to a voltage-variable attenuator in the sweep oscillator. This provides a flat rf output level over the entire frequency range. The VAR attenuator control can vary the dc reference in the leveler and thus control the rf output over a 20 dB range.

The marker circuits indicate the frequency of the rf output. Harmonic markers are selectable 1, 10 or 50 MHz apart. A sample of the rf from the sweep oscillator heterodynes with harmonics from a crystal-controlled oscillator signal to generate comb-type frequency markers. The markers are amplified and shaped in the marker amplifier, then added to the detected rf (from the device under test) and applied to the oscilloscope vertical.

The counter interface circuitry stops the sweep time ramp at the level set by the DOT POS control, and tells the counter to begin a count. When the counter finishes, sweep is resumed. Because of this sweep interruption, cw is provided to the counter (via the AUX RF output) and an intensified dot is displayed on the oscilloscope horizontal sweep that shows the location of the count.

Power supply regulators provide +18 V, -18 V, +33 V, -33 V, and +5 V for all of the circuits.

4.2 SWEEP RAMP GENERATOR

4.2.1 Basic Operation

The sweep ramp generator provides the ramp voltage that is used to sweep the rf generator and to sweep the horizontal axis of the display oscilloscope. It also provides a blanking signal that is used to turn off the rf generator and marker oscillator during sweep retrace. The output amplitude of the ramp is 10 V peak-to-peak (-5 V to +5 V). The blanking voltage switches between -18 V and +18 V. Figure 4-1 is a simplified diagram of the sweep ramp generator. The ramp risetime and negative blanking voltage correspond to the rf on-time (sweep); ramp falltime and positive blanking voltage correspond to the rf off-time (retrace).

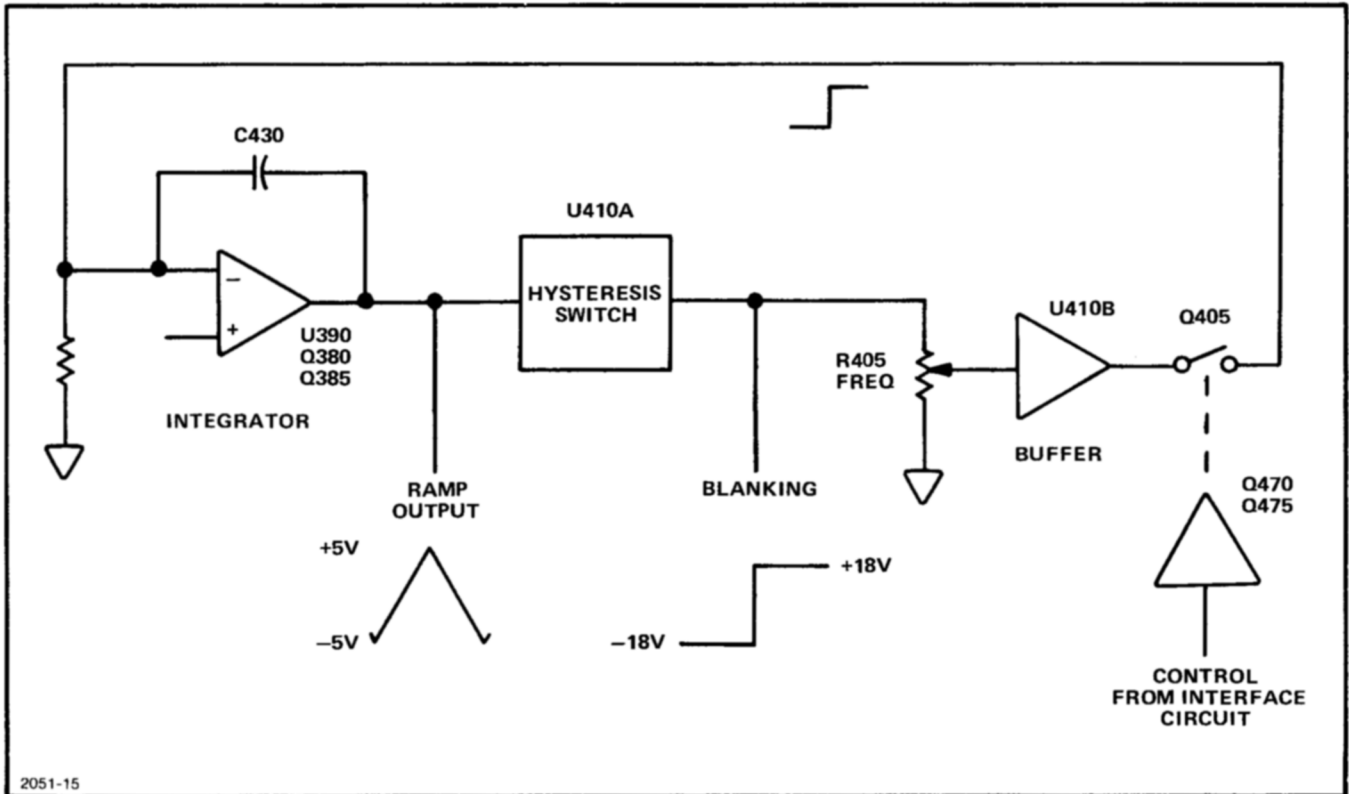


Figure 4-1. SW 503 sweep ramp generator (simplified diagram).

4.2.2 Ramp Generator

The ramp generator is an inverting integrator which includes U390, Q380, Q385, and C430, the integrating capacitor (refer to schematic). A positive dc level applied to U390 pin 2 causes the output to fall at a constant slope; a negative level causes the output to rise. These levels are generated by the hysteresis switch, described in the following paragraphs.

S372, the front panel SWEEP MODE/TIME switch, and five transistors (Q370, Q400, Q405, Q430, and Q450) switch in or out the appropriate circuitry for the desired function. The switching is not mentioned in the following discussions of the various modes.

The hysteresis switch includes U410A. The input voltage level required to switch the hysteresis switch is dependent upon its output voltage. When the output is positive (+18 V), the voltage (from the integrator) must fall to -5 V. When the hysteresis switch goes negative (-18 V), the input must rise to +5 V to switch it positive again. The hysteresis window (-5 V to +5 V) is determined by R394 and R402.

The blanking voltage output from the hysteresis switch is applied through Freq potentiometer R405 to buffer amplifier U410B. The sweep time is varied by controlling the feedback from the buffer output to the integrator input.

In the timed sweep modes (0.01 s, 0.1 s, 1 s, and 10 s per sweep), resistors R376, R378, R380, and R381 respectively determine the range. R375, the front panel VARIABLE control, adjusts the time within each range. Diode CR374 allows only the trace (rf on) time to be varied by R375, while the retrace is fixed at the fast end of the range. During the trace the feedback is a negative dc voltage, thus CR374 conducts and R375 can divide the voltage. During retrace the feedback is positive and the diode stops conducting; thus R375 acts like a series resistor which is negligible regardless of its position.

4.2.3 Single Sweep

SW370 is the PULL FOR SINGLE SWEEP switch on the rear of the VARIABLE control. Pulling the switch causes the sweep to stop at the end of retrace and await a trigger. The trigger may be provided by either the pushbutton TRIG switch, or remotely through the EXT CONTROL TRIG circuit.

The single sweep mode operates by enlarging the hysteresis window and clamping the integrator output before it reaches the hysteresis shifting point (refer to Basic Operation, Paragraph 4.2.1). The hysteresis window is shifted by CR404, which feeds back a positive output voltage. The decreasing ramp would therefore have to go farther negative than normal to switch the hysteresis switch. The integrator is clamped by a high-speed cycle of sensing the integrator output and controlling the integrator feedback to yield the proper output of -5 V dc. Comparator Q435 is off when the integrator output is more positive than -5 V. When it falls to -5 V, Q435 turns on, which turns on Q430 to provide negative feedback around the integrator. The resulting reduced gain causes the integrator output to become less negative, which turns Q435 off. This allows the integrator output to go more negative, starting the cycle over again. This sensing and correcting is so fast that the integrator output is essentially dc.

A single sweep is obtained by applying a negative pulse to the hysteresis switch, causing it to change to a negative output state. One sweep cycle occurs as in the variable rate mode, but since the positive hysteresis point is not shifted, the circuit waits at the end of the retrace. During the sweep, the trigger circuitry is disabled by a signal from the comparator until the sweep time ramp is clamped. At that time, Q435 turns on Q425, which turns on Q420, which applies power to Q460. Q460 inverts the signal on its base and applies it to a differentiating circuit (C460 and R462). When the TRIGGER button is pressed, the input to the differentiator goes from $+18$ V to 0 V and stays there until both the sweep time is again clamped and the button is released, when the voltage on the collector of Q460 is again reset to $+18$ V. The differentiator puts out a positive pulse when its input rises, and a negative pulse when the input falls. Q465 ignores the positive pulses and amplifies the negative pulses for application to the hysteresis switch.

4.2.4 Line Rate

In the LINE mode, the sweep time is adjusted by R370 to be one millisecond faster than one cycle of the ac power line. The trigger source is derived directly from the line voltage, and pulses the hysteresis switch at the beginning of the ac positive half-cycle. The single sweep feature and the VAR control do not function in the LINE mode.

4.2.5 CW Mode

The sweep ramp output is grounded in the CW mode since a swept signal is not necessary. The blanking voltage is held negative to maintain an rf output by applying a positive voltage through CR384 to pin 2 of U410A. This overrides any signal applied to pin 3.

4.2.6 MANUAL Mode

In the MANUAL mode, the rf output is swept manually by R375, the front panel VARIABLE control. In this mode, $+18$ V is applied to the VARIABLE control, and the variable output voltage is connected to the integrator, which functions as an inverting adder/attenuator. Its output swings between the same limits as before, -5 V to 5 V. The hysteresis switch and the buffer are both overridden to produce a negative output, which keeps the rf on.

4.3 SWEEP DRIVE CIRCUITRY

The sweep drive circuitry controls the rf output frequency by applying a combination of signals to the sweep oscillator module. The circuit consists of an input adder, a ramp shaping network, and an output amplifier.

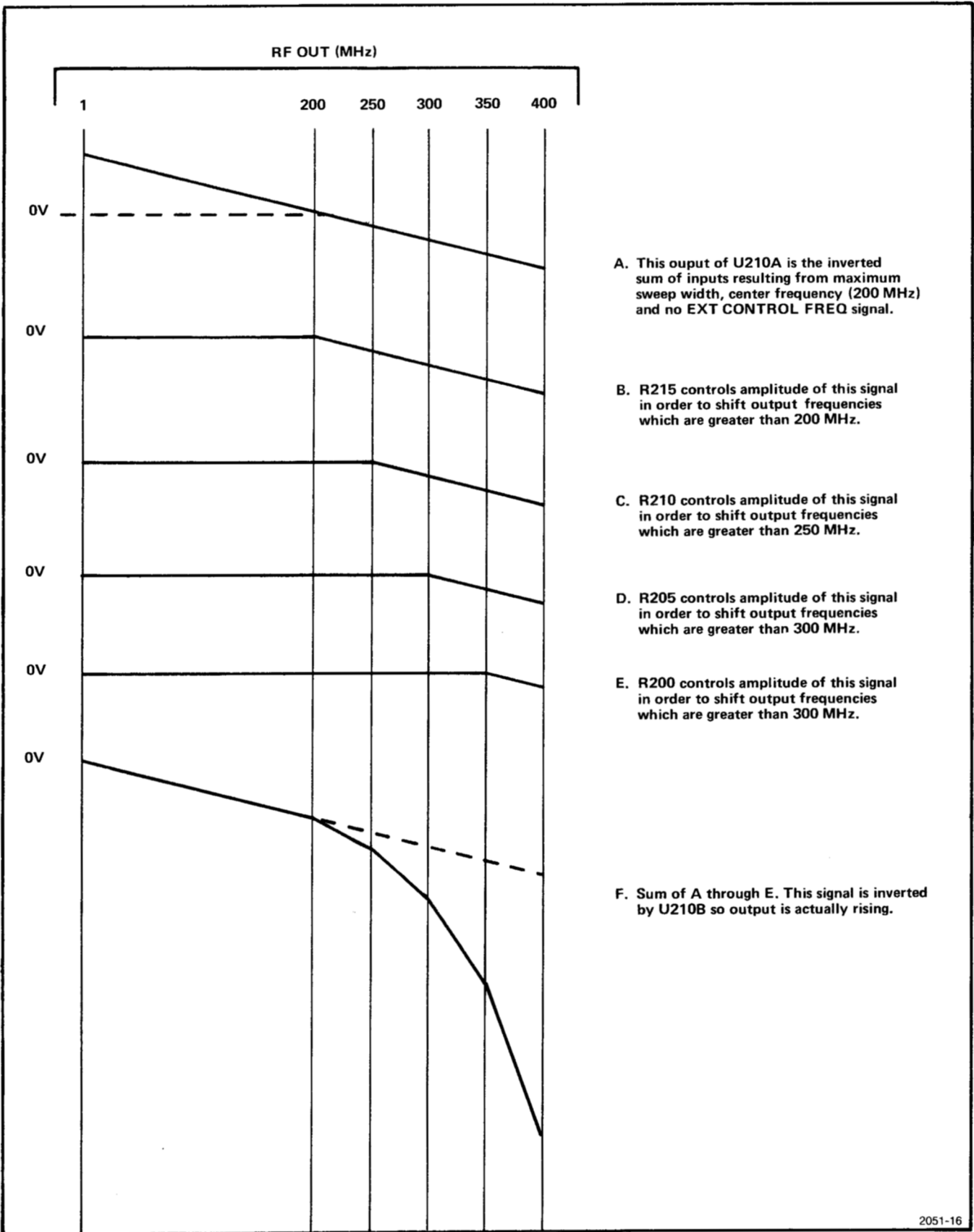
4.3.1 Input Adder

This stage (U210A) combines the following signals:

1. Ramp derived from the sweep ramp generator (in the sweeping modes only). The amplitude of this ramp is controlled by the MAX SWEEP WIDTH controls. In the MANUAL and CW modes, a dc level is applied.
2. DC level between 0 and 10 V from the CTR FREQ control. In order to cause the correct positive or negative response to the CTR FREQ control, a negative voltage is added from Bal adjustment R185.
3. Input from EXT CONTROL FREQ connector. This input can be used to remotely control the center frequency of the sweep, or for modulating the output frequency when in the MANUAL or CW modes.

4.3.2 Ramp Shaping Network

This circuit compensates for the inherent nonlinearity of the rf oscillator during the time that corresponds to the rf output between 200 MHz and 400 MHz. The circuit adds to the linear ramp up to four different segments derived from it as shown in Figure 4-2. For the following discussion the CTR FREQ control is set to 200 MHz and the MAX SWEEP WIDTH controls are set for 400 MHz. This provides a maximum amplitude ramp out of the inverting input adder of equal positive and negative amplitudes. The shaping network effects the negative portion of this ramp.



A. This output of U210A is the inverted sum of inputs resulting from maximum sweep width, center frequency (200 MHz) and no EXT CONTROL FREQ signal.

B. R215 controls amplitude of this signal in order to shift output frequencies which are greater than 200 MHz.

C. R210 controls amplitude of this signal in order to shift output frequencies which are greater than 250 MHz.

D. R205 controls amplitude of this signal in order to shift output frequencies which are greater than 300 MHz.

E. R200 controls amplitude of this signal in order to shift output frequencies which are greater than 300 MHz.

F. Sum of A through E. This signal is inverted by U210B so output is actually rising.

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Figure 4-2. Ramp shaping network.

Referring to Figure 4-2, when ramp A falls below zero, CR210 conducts, thus adding ramp B to U210B. The amplitude of ramp B is determined by R215, which therefore controls the slope of the entire right half of the ramp (the slope can only be made steeper). When the voltage on the cathode of CR206 falls below zero the diode conducts, thus adding ramp C. The voltage applied to the cathode of CR206 is ramp A with a positive offset; therefore, a zero-volt level at this point occurs at a later point in time than did that at CR210. Inputs D and E are formed in a similar manner, using different offset levels. The offset levels are achieved by applying ramp A through a voltage divider to a constant-current source, Q190. Since the currents through the diodes are negligible, the voltage drops across resistors R196, R202, and R206 are constant.

4.3.3 Output Amplifier

U210B is an inverting operational amplifier. Its input adds the segments of ramp from the ramp shaping network (F in Figure 4-2). Its output drives the rf sweep generator module. Frequency adjustment R225 adjusts the gain, thus setting the zero-frequency point.

4.4 SWEEP OSCILLATOR MODULE

The rf sweep oscillator module A20 provides a swept or cw signal from 1 MHz to 400 MHz (refer to Figure 4-3). The swept signal is generated by heterodyning the output of a 1 GHz fixed-frequency oscillator with the output of a voltage-controlled oscillator that sweeps from approximately 1001 MHz to 1400 MHz. The difference frequency is amplified, and the output amplitude is controlled by the leveler circuit, described in Subsection 4.5. Center frequency calibration is provided by driving pin 8 of the module with a dc voltage determined by R235, the Freq 200 adjustment, and buffered by U230B.

4.5 RF OSCILLATOR LEVELER

The leveler circuit serves two purposes: It maintains a constant rf output amplitude at the sweep generator module output over the swept frequency range, and it allows output level adjustment or modulation via the front-panel CAL (attenuation) control of EXT CONTROL AMPL connector. The output is leveled by a detector, comparator, and voltage variable attenuator loop (see Figure 4-3). The detector and voltage variable attenuator are inside the rf oscillator module; U250A is the comparator. The detector outputs a dc voltage proportional to the rf amplitude at the various frequencies. If the voltage deviates from the dc reference, the comparator immediately changes the voltage to the voltage variable attenuator, thus increasing or decreasing the rf applied to the amplifier. The result is a flat rf output.

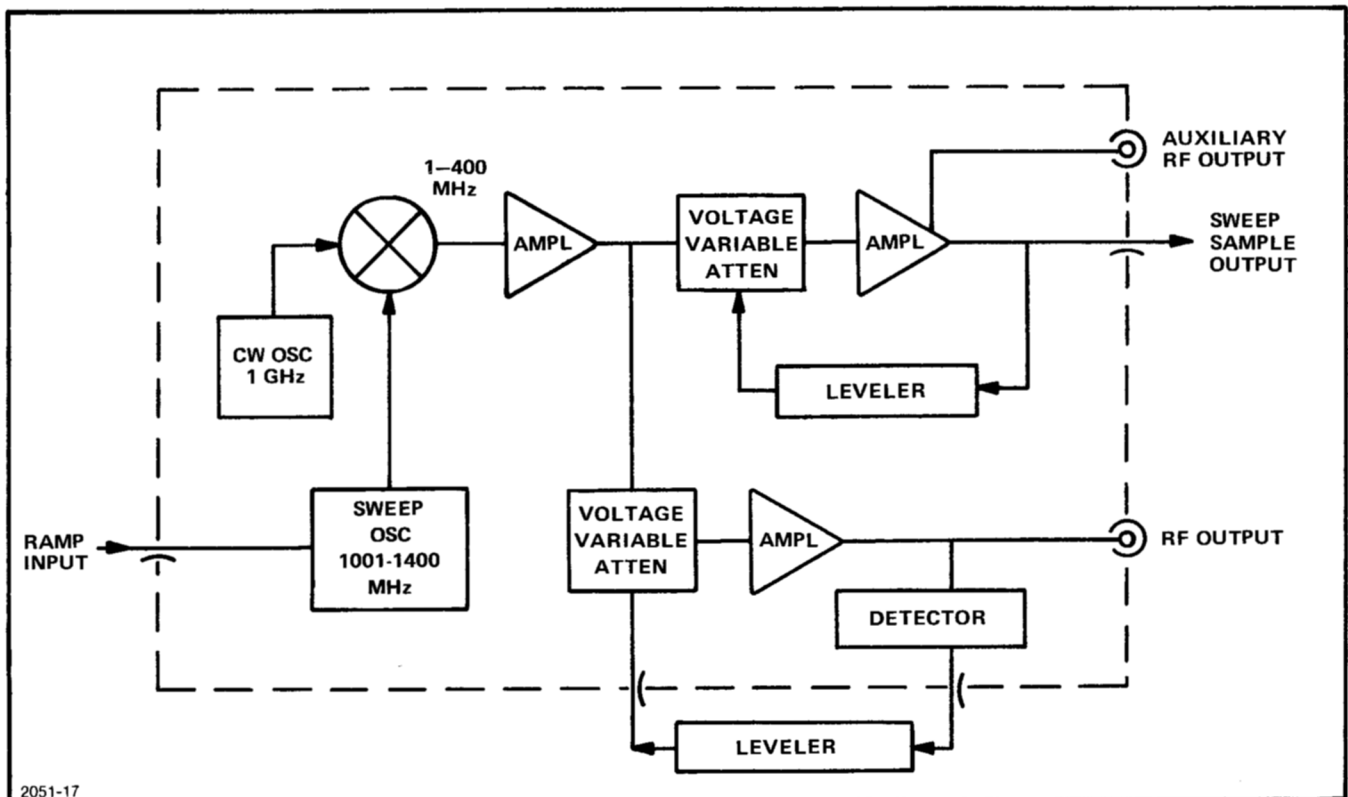
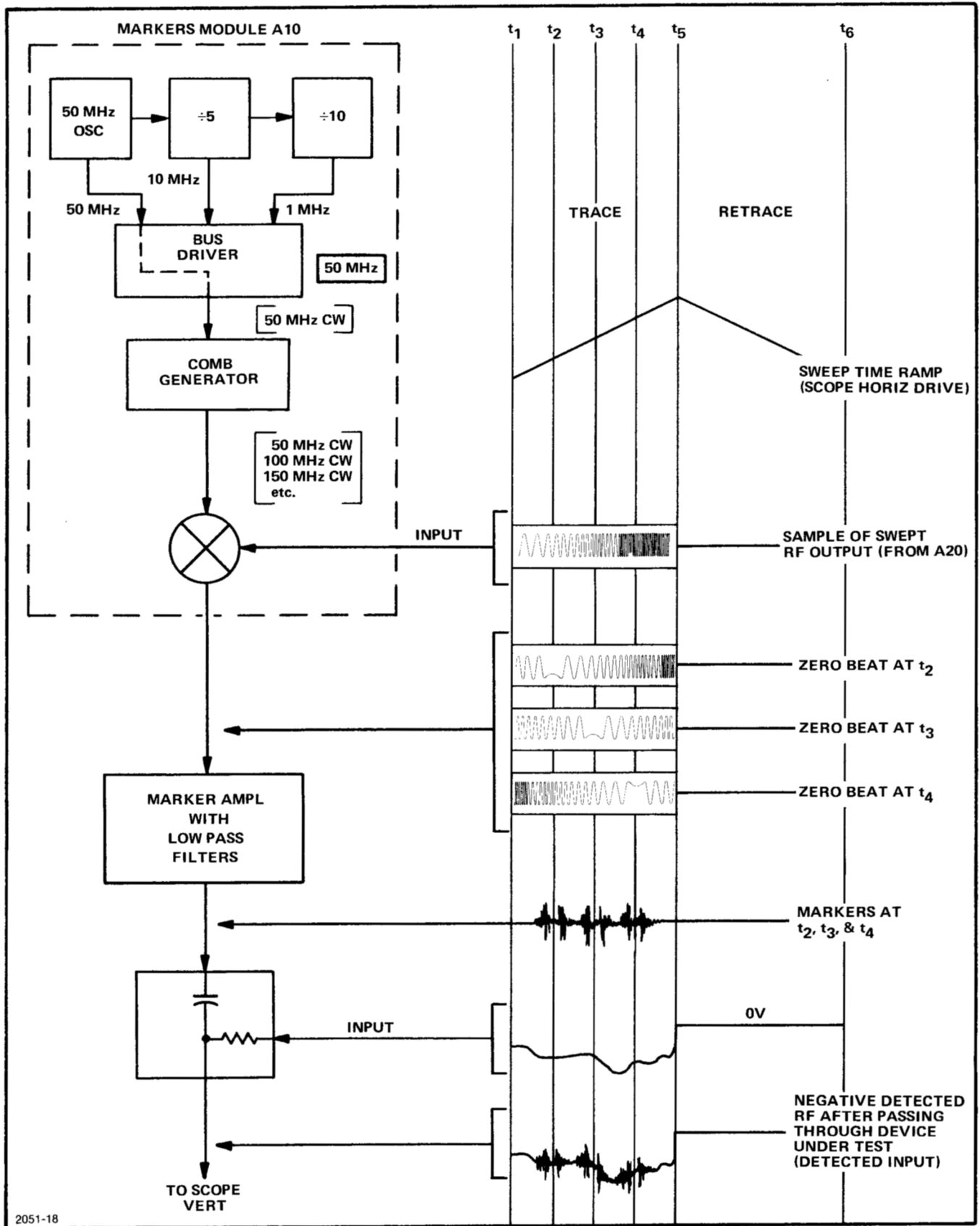


Figure 4-3. RF sweep oscillator module block diagram.



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Figure 4-4. Harmonic comb markers block diagram.

The output level is adjustable by varying the dc reference input to comparator U250A. The front-panel CAL potentiometer (R20) controls the rf output level over a 20 dB range; the range is adjusted by R240 and R245. The voltage applied to the CAL control is about -4.8 V from U250B when no external signal is applied. The EXT CONTROL AMPL connector permits applying an external signal to U250B to either provide external level control or amplitude modulation.

4.6 HARMONIC MARKER MODULE

The harmonic marker module mixes a sample of the rf output with one of three harmonic combs to generate a series of zero beat markers. The front-panel marker switch assembly includes three interlocking pushbuttons to allow only one harmonic marker output to operate at a time. See Figure 4-4 for a block diagram of the markers system.

The marker module contains a 50 MHz oscillator whose output is used directly, or counted down to 10 MHz or to 1 MHz. These three outputs are fed to an integrated circuit bus driver, where only one output is selected at a time. The driver output is applied to a step recovery diode which generates all harmonics of the applied frequency up to 400 MHz. This harmonic comb is then applied to a diode that mixes it with the sweep sample signal. The difference frequencies are a series of zero beats which are sent to the marker amplifier.

4.7 MARKER AMPLIFIER

The marker amplifier and its filters determine the size and shape of the markers before they are added to the detected rf signal (refer to Figure 4-4). The input, from the markers module, goes to a preamplifier consisting of Q110 and Q120. The preamplifier provides a high impedance input and a buffered output which feeds the Size 1 MHz adjustment. When the 10 MHz or 50 MHz markers are turned on, the marker switch assembly also sends a signal to Q130, which switches in an additional (Size 10/50) adjustment to attenuate the 10 and 50 MHz markers (which are normally larger than the 1 MHz markers). The markers then pass to Q135, whose load includes switchable width-determining circuitry. This circuitry maintains a visible marker by switching the marker width (marker frequency bandwidth) when the maximum sweep width is changed. Wide markers are achieved by applying $+18$ V to L140 and C140. In the medium width position, $+18$ V also turns on Q140 which connects C142 to ground. In the narrow width position, $+18$ V is removed from L140 and C140 and applied to Q140 and Q145, which shorts both C142 and C146 to ground. The markers are then amplified by operational amplifier U150 and applied to a push-pull stage (Q160 and Q165). The markers drive this stage into saturation so that each marker is the same size on the oscilloscope display. The markers pass through the front-panel SIZE control and an internal switch that selects either normal (attenuated) markers for addition to an oscilloscope display, or detected markers for addition to a chart recorder display (since a chart recorder pen cannot respond to the frequency of the undetected markers).

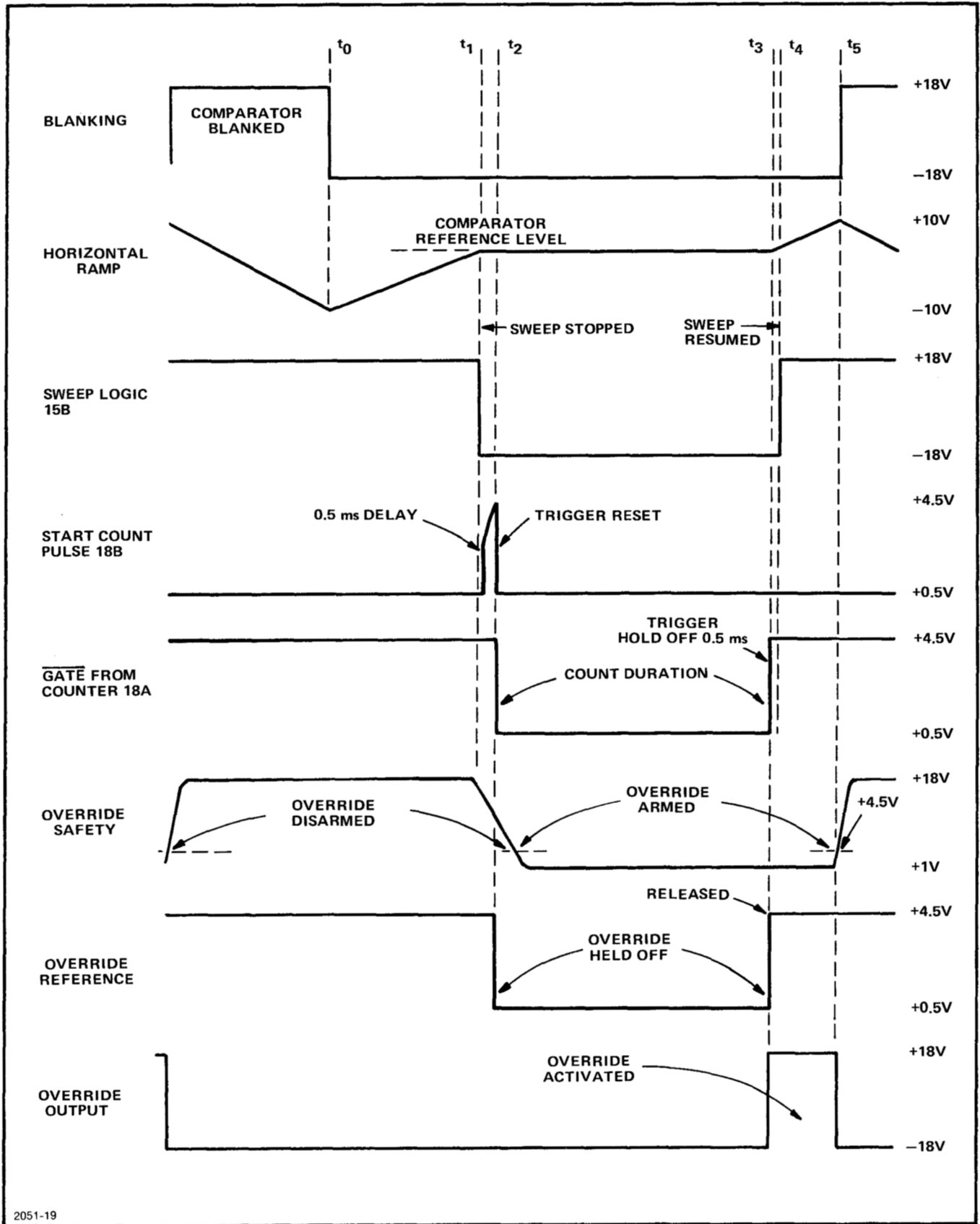


Figure 4-5. Counter interface signals sequence.

4.8 COUNTER INTERFACE

The purpose of the counter interface is to stop the frequency sweep at some predetermined point, tell the counter to read the frequency at that point, then to continue the sweep from the point at which it was interrupted. The point at which the sweep stops is determined by the DOT POSITION control on the front panel. A visible dot indicating the counter frequency point is present only at the LINE and 0.01 s sweep rates. The following circuit discussion assumes the presence of a counter with sweep-interrupt logic, such as the DC 502 Option 7. Refer to Figure 4-5, as well as the schematic, for the following discussion, which follows the interface signals sequence.

Before t_0 —The SW 503 is executing retrace. The sweep ramp is falling, the blanking signal is +18 V, and the rf output is blanked off. The blanking signal is connected through CR294 to the noninverting input of comparator U280A. This overrides any other signal to the comparator, thus causing its output to be +18 V. The comparator drives an amplifier (Q470 and Q475) in the sweep ramp circuit which drives a FET switch. The positive comparator output closes the switch, thus closing the loop around the integrator/hysteresis switch oscillator, which maintains the ramp output.

t_0 —At time t_0 , the blanking signal switches to -18 V and the sweep ramp starts to rise. The rf generator is turned on and starts its sweep. The output of U280B is -18 V at this time, so CR290 prevents any effect on pin 2 of U280A. The comparator output remains positive until the instantaneous amplitude of the ramp signal to pin 2 of U280A is more positive than the dc level to pin 3, selected by the DOT POSITION control.

t_1 —When the ramp reaches the reference level, comparator U280A switches to -18 V. This opens Q405 and stops the integrator, which keeps the ramp from rising further. When the previously-positive output of U280A is no longer applied through CR296 to Q290, Q290 opens, its collector rising from 0.5 V to 4.5 V. This signal is sent to the counter, which starts counting. Before t_0 the +18 V blanking through CR292 charged up C290. CR292 allowed the charge to remain after the blanking went negative. At t_1 , when U280A switches negative, C290 starts discharging through CR282, CR284, and CR286. CR288 limits discharge to about 1 V. Pin 6 reaches 1 V some time after t_2 .

t_2 —When the counter starts counting, the voltage applied to Q270 drops from 4.5 V to 0.5 V, turning it off and raising the collector from 0 to +18 V. This voltage is applied through CR274 to turn on Q290 again and reset the trigger pulse. The voltage is also applied to Q275, which turns on, dropping pin 5 of U280B from 4.5 V to 0 V.

Although pin 6 has been discharging since T_1 , its voltage remains higher than that on pin 5, thus output on pin 7 remains negative.

t_3 to t_4 —When the counter is done counting, pin 18A is switched to 4.5 V, which switches the collector of Q270 to 0 V. Q275 turns off, allowing pin 5 of U280B to be pulled up to 4.5 V. Since pin 6 is still about 1 V, U280B switches its output to +18 V. The positive voltage applied to U280A flips the output positive. The above sequence occurs between t_3 and t_4 . At t_3 , when the collector of Q270 goes to 0 V, the positive voltage is removed from CR274, but the charge on C296 keeps Q290 turned on until t_4 , when +18 V from U280A can take over holding Q290 on. The output of U280A, having switched positive, again closes the integrator/hysteresis switch loop by turning on Q405. The sweep ramp then continues to rise from the level at which it was stopped.

t_4 to t_5 —The override is activated by the relative voltages on the inputs of U280B. After t_4 , there is no voltage source for C290, since the blanking signal is negative and the comparator output is positive. During very slow sweep times C290 tends to charge positively. To prevent U280B from switching negative, CR280 and R282 provide positive feedback.

t_5 —At t_5 the blanking signal returns positive. C290 is charged up again, causing the output to switch to -18 V. This allows U280A to again start comparing the ramp level to the level set by the MARKERS DOT POS control.

The SW 503 will not gate the counter in the MANUAL position of the SWEEP MODE/TIME switch. In this position, +18 V from the switch is applied through CR289 to pin 3 of U280A. This overrides any voltage on pin 2, thus keeping the output positive, which keeps the integrator/hysteresis switch loop closed and prevents a trigger to the counter.

When the counter is not present, the ground is removed from Q278, allowing pin 5 of U280B to rise to +18 V instead of +4.5 V. This maintains a positive voltage on the output of U280B and U280A, thereby ensuring that the integrator/hysteresis loop stays closed.

If, during normal operation, the counter is told by Q290 to start counting but the counter does not switch the signal to Q270 to 0.5 V, the circuit must be able to start the sweep time circuit again. If the input to Q270 remains at 4.5 V, pin 5 of U280B will remain at 4.5 V, and C290 will start to discharge at t_2 . When pin 6 falls below 4.5 V, U280B output will switch to +18 V, which causes the sweep cycle to start again.

IMPLEMENTING SPECIAL FEATURES

5.1 CHANGING HORIZONTAL OUTPUT VOLTAGE

The SW 503 SCOPE HORIZ (X-axis output), when in a sweeping mode, is a triangular waveform symmetrical about 0 V with an amplitude of 500 mV p-p, and an output impedance of 1 k Ω . For oscilloscopes or other display devices requiring a higher output voltage, the voltage is easily changed to 10 V p-p with an output impedance of 20 k Ω . To accomplish this, simply remove R25, the 1 k Ω resistor located between the rear of the SCOPE HORIZ connector and ground on the circuit board.

5.2 INTERFACE THROUGH REAR PLUG-IN CONNECTOR

5.2.1 Introduction

The SW 503 has provisions for interconnection with other units or control sources through the rear plug-in connector, thereby eliminating the need for some of the front panel connections. The features that can be duplicated through the rear connector are:

- Vertical output (SCOPE VERT)
- Horizontal output (SCOPE HORIZ)
- External trigger input (EXT CONTROL TRIG)
- Amplitude control (EXT CONTROL AMPL)
- Frequency control (EXT CONTROL FREQ)

The RF OUT, AUX RF, and DETECTED INPUT are not intended to be accessed through the rear connector due to the degradation of performance and potential crosstalk problems. Digital counter interface lines are described in Paragraph 5.2.7.

Refer to Figure 3-1 for connector P40 location, and to Figure 5-1 for rear plug-in connector contact locations. Note that both A and B sides of the rear plug-in connector can be soldered from either side of the circuit board.

5.2.2 Mainframe Modification

In addition to installing the wires as described below, the TM 500 Series mainframe must be modified by adding wires between the appropriate connector pins as necessary. When this is done, the mainframe generally becomes dedicated to a particular plug-in type, rather than accepting any TM 500 Series plug-in.

The digital counter interface lines are factory installed, when a mainframe with Option 7 is ordered. These particular lines can also be field-installed by ordering Field Modification Kit 040-0789-00.



When a Power Module compartment has been selected for the SW 503 and wired for a specialized interface system, a plastic barrier (Tektronix Part No. 214-1593-02) should be installed in a key slot between contacts 23 and 24 on the Power Module.

Do not insert any TM 500 Series plug-in in a live power module and do not use excessive force when inserting the plug-in.

5.2.3 Vertical Output (Y axis) and Horizontal Output (X axis)

a. Install a solder lug (such as Tektronix Part No. 210-0302-00) under the SCOPE HORIZ connector.

b. Strip the ends of a 12-inch length of miniature coaxial cable (such as Tektronix Part No. 175-1020-00). Refer to Figure 5-1 for the following steps.

c. For the vertical signal, solder the coaxial cable from the center pin of the SCOPE VERT connector (coax center conductor) and the ground lug (coax shield) to rear plug-in connector contact 28B (center conductor) and 28A (shield).

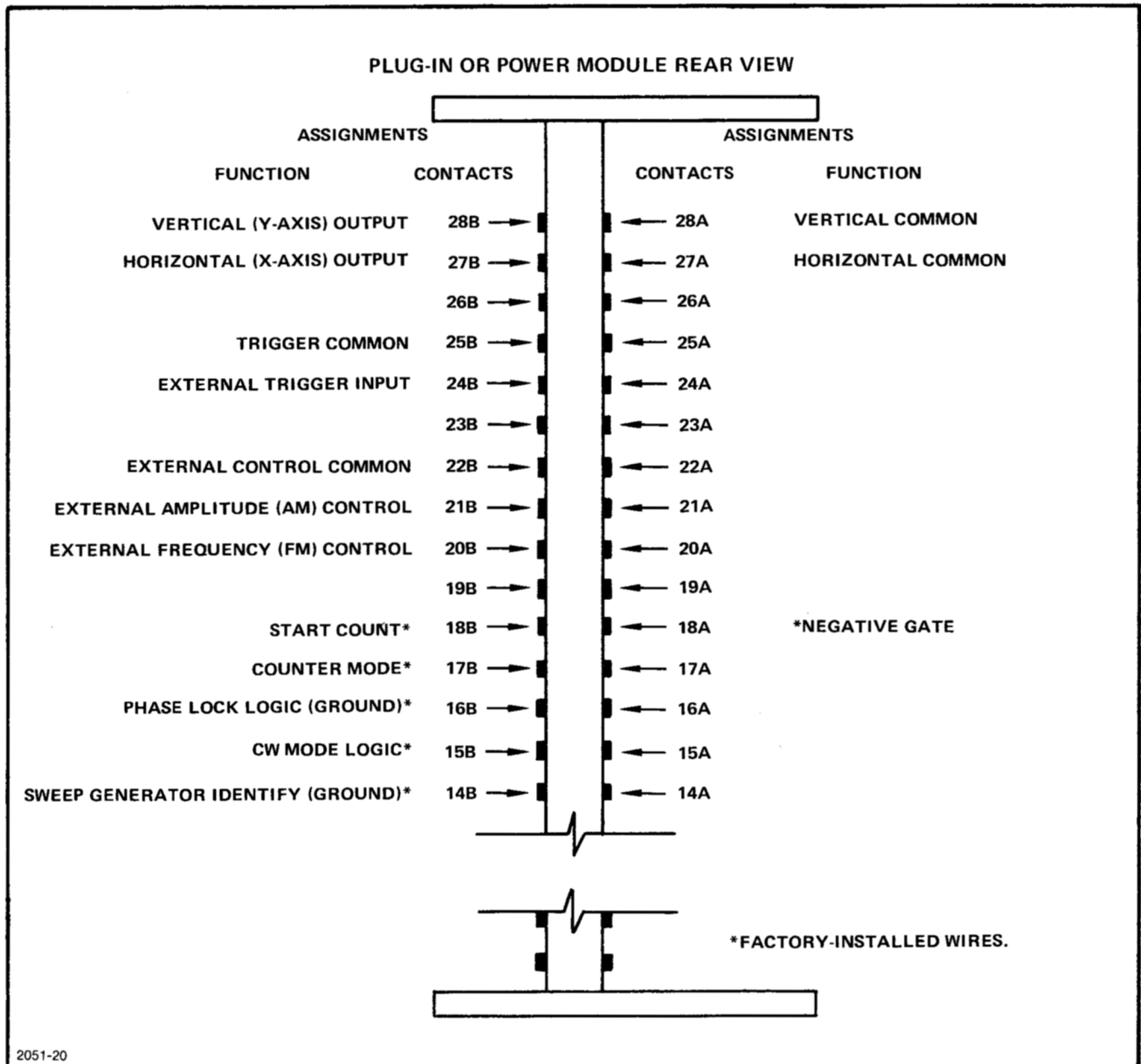


Figure 5-1. Rear plug-in connector P40 interface wiring.

d. For the horizontal signal, solder the coaxial cable from the center pin of the SCOPE HORIZ connector (coax center conductor) and the ground lug (coax shield) to rear plug-in connector contact 27B (coax center conductor) and 27A (shield).

5.2.4 External Frequency Control or Modulation

a. Connect a wire between P40 pin 4 (locate in Figure 3-4) and rear plug-in connector contact 20B (marked "FM" on board; locate in Figure 5-1).

b. Connect a wire between P40 pin 1 (GND) and rear plug-in connector contact 22B.

5.2.5 External Amplitude Control or Modulation

a. Connect a wire between P40 pin 3 (locate in Figure 3-4) and rear plug-in connector contact 21B (marked "AM" on board; locate in Figure 5-1).

b. Connect a wire (if not already installed) between P40 pin 1 (GND) and rear plug-in connector contact 22B.

5.2.6 External Trigger

a. Connect a wire between P40 pin 7 (locate in Figure 3-4) and rear plug-in connector contact 24B (marked "TRIG" on board; locate in Figure 5-1).

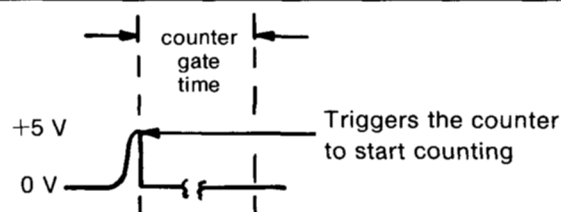
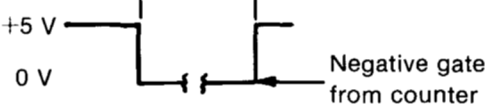
b. Connect a wire between P40 pin 1 (GND) and rear plug-in connector contact 25B.

5.2.7 Digital Counter Interface

The digital counter interface wires are factory-installed at contacts 14B through 18B and 18A, as denoted by

asterisks in Figure 5-1. These lines, described fully in the following table, are intended to interface with the DC 502 Option 7 Digital Counter; other counters may need to be modified. All lines use standard TTL voltages (0 V and +5 V). The six interface lines are used as indicated in Table 5-1.

Table 5-1
DIGITAL COUNTER INTERFACE LINES

| Line Name | Connector Contact Number | Description |
|--------------------------|--------------------------|---|
| Start count | B18 |  |
| $\overline{\text{GATE}}$ | A18 |  |
| Phase lock logic | B16 | +5 V — — — 100 kHz resolution count 0 V — — — 10 Hz resolution count |
| CW Mode logic | B15 | +5 V — — — Dot Marker Function 0 V — — — Normal counter functions |
| Sweep Generator Identify | B14 | 0 V — — — Grounded when SW 503 is plugged in |
| Counter Identify | B17 | +5 V — — — Counter not installed in mainframe 0 V — — — Counter installed in mainframe |

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

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

| Mfr. Code | Manufacturer | Address | City, State, Zip |
|-----------|--|--|-----------------------------|
| 01121 | ALLEN-BRADLEY COMPANY | 1201 2ND STREET SOUTH | MILWAUKEE, WI 53204 |
| 01295 | TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP | P O BOX 5012, 13500 N CENTRAL EXPRESSWAY | DALLAS, TX 75222 |
| 02111 | SPECTROL ELECTRONICS CORPORATION | 17070 EAST GALE AVENUE | CITY OF INDUSTRY, CA 91745 |
| 04222 | AVX CERAMICS, DIVISION OF AVX CORP. | P O BOX 867, 19TH AVE. SOUTH | MURTL BEACH, SC 29577 |
| 04713 | MOTOROLA, INC., SEMICONDUCTOR PROD. DIV. | 5005 E MCDOWELL RD, PO BOX 20923 | PHOENIX, AZ 85036 |
| 07910 | TELEDYNE SEMICONDUCTOR | 12515 CHADRON AVE. | HAWTHORNE, CA 90250 |
| 08806 | GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT | NELA PARK | CLEVELAND, OH 44112 |
| 27014 | NATIONAL SEMICONDUCTOR CORP. | 2900 SEMICONDUCTOR DR. | SANTA CLARA, CA 95051 |
| 32997 | BOURNS, INC., TRIMPOT PRODUCTS DIV. | 1200 COLUMBIA AVE. | RIVERSIDE, CA 92507 |
| 34280 | WAVETEK INDIANA, INC. | PO BOX 190, 66N FIRST AVENUE | BEECH GROVE, IN 46107 |
| 56289 | SPRAGUE ELECTRIC CO. | | NORTH ADAMS, MA 01247 |
| 72982 | ERIE TECHNOLOGICAL PRODUCTS, INC. | 644 W. 12TH ST. | ERIE, PA 16512 |
| 73138 | BECKMAN INSTRUMENTS, INC., HELIPOT DIV. | 2500 HARBOR BLVD. | FULLERTON, CA 92634 |
| 73445 | AMPEREX ELECTRONIC CORP. | 230 DUFFY AVE. | HICKSVILLE, L. I., NY 11802 |
| 76493 | BELL INDUSTRIES, INC., MILLER, J. W., DIV. | 19070 REYES AVE., P O BOX 5825 | COMPTON, CA 90224 |
| 80009 | TEKTRONIX, INC. | P O BOX 500 | BEAVERTON, OR 97077 |
| 91637 | DALE ELECTRONICS, INC. | P. O. BOX 609 | COLUMBUS, NE 68601 |

| Ckt No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---------|--------------------|----------------------|--------|--------------------------------------|----------|------------------|
| C10 | 281-0550-00 | | | CAP.,FXD,CER DI:120PF,10%,500V | 04222 | 7001-1373 |
| C110 | 283-0333-00 | | | CAP.,FXD,CER DI:35PF,5%,1000V | 72982 | 858-000-COG-350J |
| C112 | 283-0000-00 | | | CAP.,FXD,CER DI:0.001UF,+100-0%,500V | 72982 | 831-516E102P |
| C114 | 283-0187-00 | | | CAP.,FXD,CER DI:0.047UF,10%,400V | 72982 | 8131N401X5R473K |
| C120 | 283-0187-00 | | | CAP.,FXD,CER DI:0.047UF,10%,400V | 72982 | 8131N401X5R473K |
| C138 | 290-0175-00 | | | CAP.,FXD,ELCTLT:10UF,20%,35V | 56289 | 150D106X0035R2 |
| C140 | 283-0000-00 | | | CAP.,FXD,CER DI:0.001UF,+100-0%,500V | 72982 | 831-516E102P |
| C142 | 283-0104-00 | | | CAP.,FXD,CER DI:2000PF,5%,500V | 72982 | 811-565B202J |
| C144 | 283-0187-00 | | | CAP.,FXD,CER DI:0.047UF,10%,400V | 72982 | 8131N401X5R473K |
| C146 | 283-0204-00 | | | CAP.,FXD,CER DI:0.01UF,20%,50V | 72982 | 8121N075Z5U0103M |
| C154 | 283-0187-00 | | | CAP.,FXD,CER DI:0.047UF,10%,400V | 72982 | 8131N401X5R473K |
| C158 | 283-0187-00 | | | CAP.,FXD,CER DI:0.047UF,10%,400V | 72982 | 8131N401X5R473K |
| C162 | 290-0309-00 | | | CAP.,FXD,ELCTLT:100UF,20%,25V | 56289 | 109D107X0025F2 |
| C166 | 290-0175-00 | | | CAP.,FXD,ELCTLT:10UF,20%,35V | 56289 | 150D106X0035R2 |
| C176 | 290-0175-00 | | | CAP.,FXD,ELCTLT:10UF,20%,35V | 56289 | 150D106X0035R2 |
| C217 | 290-0175-00 | | | CAP.,FXD,ELCTLT:10UF,20%,35V | 56289 | 150D106X0035R2 |
| C234 | 290-0175-00 | | | CAP.,FXD,ELCTLT:10UF,20%,35V | 56289 | 150D106X0035R2 |
| C256 | 283-0256-00 | | | CAP.,FXD,CER DI:130PF,5%,100V | 72982 | 8121B145P3K131J |
| C264 | 283-0077-00 | | | CAP.,FXD,CER DI:330PF,5%,500V | 56289 | 40C94A3 |
| C290 | 290-0183-00 | | | CAP.,FXD,ELCTLT:1UF,10%,35V | 56289 | 162D105X9035CD2 |
| C296 | 283-0104-00 | | | CAP.,FXD,CER DI:2000PF,5%,500V | 72982 | 811-565B202J |
| C301 | 290-0309-00 | | | CAP.,FXD,ELCTLT:100UF,20%,25V | 56289 | 109D107X0025F2 |
| C304 | 283-0004-00 | | | CAP.,FXD,CER DI:0.02UF,+80-20%,150V | 72982 | 855-558-Z5V0203Z |
| C306 | 283-0000-00 | | | CAP.,FXD,CER DI:0.001UF,+100-0%,500V | 72982 | 831-516E102P |
| C312 | 290-0309-00 | | | CAP.,FXD,ELCTLT:100UF,20%,25V | 56289 | 109D107X0025F2 |
| C314 | 283-0000-00 | | | CAP.,FXD,CER DI:0.001UF,+100-0%,500V | 72982 | 831-516E102P |
| C324 | 283-0004-00 | | | CAP.,FXD,CER DI:0.02UF,+80-20%,150V | 72982 | 855-558-Z5V0203Z |
| C326 | 290-0244-00 | | | CAP.,FXD,ELCTLT:0.47UF,5%,35V | 56289 | 162D474X5035BC2 |
| C328 | 290-0309-00 | | | CAP.,FXD,ELCTLT:100UF,20%,25V | 56289 | 109D107X0025F2 |
| C430 | 285-0930-00 | | | CAP.,FXD,PLSTC:0.12UF,5%,200V | 34280 | CP103-415 |
| C432 | 283-0078-00 | | | CAP.,FXD,CER DI:0.001UF,20%,500V | 56289 | 20C114A8 |
| C444 | 283-0027-00 | | | CAP.,FXD,CER DI:0.02UF,20%,50V | 56289 | 273C32 |
| C460 | 283-0027-00 | | | CAP.,FXD,CER DI:0.02UF,20%,50V | 56289 | 273C32 |
| C464 | 283-0032-00 | | | CAP.,FXD,CER DI:470PF,5%,500V | 72982 | 831-500Z5D471J |
| C470 | 283-0347-00 | | | CAP.,FXD,CER DI:68PF,5%,100V | 72982 | 8121A108P3K680J |
| C514 | 283-0109-00 | | | CAP.,FXD,CER DI:27PF,5%,1000V | 56289 | 20C376 |
| CR134 | 152-0066-00 | | | SEMICONV DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR136 | 152-0066-00 | | | SEMICONV DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR148 | 152-0066-00 | | | SEMICONV DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR190 | 152-0066-00 | | | SEMICONV DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR196 | 152-0066-00 | | | SEMICONV DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR200 | 152-0066-00 | | | SEMICONV DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR206 | 152-0066-00 | | | SEMICONV DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR210 | 152-0066-00 | | | SEMICONV DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR268 | 152-0066-00 | | | SEMICONV DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR274 | 152-0066-00 | | | SEMICONV DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR280 | 152-0066-00 | | | SEMICONV DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR282 | 152-0066-00 | | | SEMICONV DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR284 | 152-0066-00 | | | SEMICONV DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR286 | 152-0066-00 | | | SEMICONV DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR288 | 152-0066-00 | | | SEMICONV DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR289 | 152-0066-00 | | | SEMICONV DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |

Replaceable Electrical Parts—SW 503

| Ckt No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---------|--------------------|----------------------|--------|-------------------------------------|----------|-----------------|
| CR290 | 152-0066-00 | | | SEMICON D DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR292 | 152-0066-00 | | | SEMICON D DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR294 | 152-0066-00 | | | SEMICON D DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR296 | 152-0066-00 | | | SEMICON D DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR301 | 152-0066-00 | | | SEMICON D DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR304 | 152-0141-02 | | | SEMICON D DEVICE:SILICON,30V,150MA | 07910 | 1N4152 |
| CR310 | 152-0141-02 | | | SEMICON D DEVICE:SILICON,30V,150MA | 07910 | 1N4152 |
| CR312 | 152-0141-02 | | | SEMICON D DEVICE:SILICON,30V,150MA | 07910 | 1N4152 |
| CR314 | 152-0141-02 | | | SEMICON D DEVICE:SILICON,30V,150MA | 07910 | 1N4152 |
| CR316 | 152-0066-00 | | | SEMICON D DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR320 | 152-0141-02 | | | SEMICON D DEVICE:SILICON,30V,150MA | 07910 | 1N4152 |
| CR374 | 152-0066-00 | | | SEMICON D DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR384 | 152-0066-00 | | | SEMICON D DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR404 | 152-0066-00 | | | SEMICON D DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR414 | 152-0066-00 | | | SEMICON D DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR450 | 152-0066-00 | | | SEMICON D DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR452 | 152-0066-00 | | | SEMICON D DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR454 | 152-0066-00 | | | SEMICON D DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR456 | 152-0066-00 | | | SEMICON D DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR458 | 152-0066-00 | | | SEMICON D DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR460 | 152-0066-00 | | | SEMICON D DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR472 | 152-0066-00 | | | SEMICON D DEVICE:SILICON,400V,750MA | 80009 | 152-0066-00 |
| CR514 | 152-0129-00 | | | SEMICON D DEVICE:GERMANIUM,10V,23UA | 73445 | 1N87A |
| DS1 | 150-0048-01 | | | LAMP, INCAND:5V,0.06A,SEL | 08806 | 683AS15 |
| L140 | 108-0324-00 | | | COIL, RF:10MH | 76493 | 70F102A1 |
| L160 | 108-0813-00 | | | COIL, RF:10UH | 80009 | 108-0813-00 |
| L166 | 108-0813-00 | | | COIL, RF:10UH | 80009 | 108-0813-00 |
| Q110 | 151-1005-00 | | | TRANSISTOR:SILICON,JFE,N-CHANNEL | 80009 | 151-1005-00 |
| Q120 | 151-0639-00 | | | TRANSISTOR:SILICON,NPN | 80009 | 151-0639-00 |
| Q130 | 151-1005-00 | | | TRANSISTOR:SILICON,JFE,N-CHANNEL | 80009 | 151-1005-00 |
| Q135 | 151-0639-00 | | | TRANSISTOR:SILICON,NPN | 80009 | 151-0639-00 |
| Q140 | 151-1005-00 | | | TRANSISTOR:SILICON,JFE,N-CHANNEL | 80009 | 151-1005-00 |
| Q145 | 151-1005-00 | | | TRANSISTOR:SILICON,JFE,N-CHANNEL | 80009 | 151-1005-00 |
| Q160 | 151-0641-00 | | | TRANSISTOR:SILICON,PNP | 80009 | 151-0641-00 |
| Q165 | 151-0641-00 | | | TRANSISTOR:SILICON,PNP | 80009 | 151-0641-00 |
| Q190 | 151-0219-00 | | | TRANSISTOR:SILICON,PNP | 80009 | 151-0219-00 |
| Q250 | 151-1005-00 | | | TRANSISTOR:SILICON,JFE,N-CHANNEL | 80009 | 151-1005-00 |
| Q270 | 151-0641-00 | | | TRANSISTOR:SILICON,PNP | 80009 | 151-0641-00 |
| Q275 | 151-0641-00 | | | TRANSISTOR:SILICON,PNP | 80009 | 151-0641-00 |
| Q290 | 151-0641-00 | | | TRANSISTOR:SILICON,PNP | 80009 | 151-0641-00 |
| Q300 | 151-0190-00 | | | TRANSISTOR:SILICON,NPN | 80009 | 151-0190-00 |
| Q305 | 151-0134-00 | | | TRANSISTOR:SILICON,PNP | 80009 | 151-0134-00 |
| Q308 | 151-0190-00 | | | TRANSISTOR:SILICON,NPN | 80009 | 151-0190-00 |
| Q310 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 01295 | 2N3906 |
| Q315 | 151-0103-00 | | | TRANSISTOR:SILICON,NPN | 04713 | 2N2219A |
| Q320 | 151-0188-00 | | | TRANSISTOR:SILICON,PNP | 01295 | 2N3906 |
| Q360 | 151-0641-00 | | | TRANSISTOR:SILICON,PNP | 80009 | 151-0641-00 |
| Q370 | 151-1005-00 | | | TRANSISTOR:SILICON,JFE,N-CHANNEL | 80009 | 151-1005-00 |
| Q380 | 151-1005-00 | | | TRANSISTOR:SILICON,JFE,N-CHANNEL | 80009 | 151-1005-00 |
| Q385 | 151-1005-00 | | | TRANSISTOR:SILICON,JFE,N-CHANNEL | 80009 | 151-1005-00 |
| Q400 | 151-1005-00 | | | TRANSISTOR:SILICON,JFE,N-CHANNEL | 80009 | 151-1005-00 |
| Q405 | 151-1005-00 | | | TRANSISTOR:SILICON,JFE,N-CHANNEL | 80009 | 151-1005-00 |

| Ckt No. | Tektronix Part No. | Serial/Model No. Eff Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---------|--------------------|-----------------------------|------------------------------------|----------|-----------------|
| Q420 | 151-1005-00 | | TRANSISTOR:SILICON,JFE,N-CHANNEL | 80009 | 151-1005-00 |
| Q425 | 151-0638-00 | | TRANSISTOR:SILICON,PNP | 80009 | 151-0638-00 |
| Q430 | 151-1005-00 | | TRANSISTOR:SILICON,JFE,N-CHANNEL | 80009 | 151-1005-00 |
| Q435 | 151-0641-00 | | TRANSISTOR:SILICON,PNP | 80009* | 151-0641-00 |
| Q450 | 151-1005-00 | | TRANSISTOR:SILICON,JFE,N-CHANNEL | 80009 | 151-1005-00 |
| Q460 | 151-0638-00 | | TRANSISTOR:SILICON,PNP | 80009 | 151-0638-00 |
| Q465 | 151-0638-00 | | TRANSISTOR:SILICON,PNP | 80009 | 151-0638-00 |
| Q470 | 151-0637-00 | | TRANSISTOR:SILICON,NPN | 80009 | 151-0637-00 |
| Q475 | 151-0640-00 | | TRANSISTOR:SILICON,PNP | 80009 | 151-0640-00 |
| R5 | 118-0084-00 | | RES.,VAR,WW:10K OHM,5%,1.5W | 32997 | 3610S-534-103 |
| R10 | 315-0105-00 | | RES.,FXD,CMPSN:1M OHM,5%,0.25W | 01121 | CB1055 |
| R15 | 315-0473-00 | | RES.,FXD,CMPSN:47K OHM,5%,0.25W | 01121 | CB4735 |
| R20 | ----- | | RESISTOR,VAR:10K OHM | 34280 | RP146-310 |
| R25 | 321-0193-00 | | RES.,FXD,FILM:1K OHM,1%,0.125W | 91637 | MFF1816G10000F |
| R110 | 315-0105-00 | | RES.,FXD,CMPSN:1M OHM,5%,0.25W | 01121 | CB1055 |
| R112 | 315-0822-00 | | RES.,FXD,CMPSN:8.2K OHM,5%,0.25W | 01121 | CB8225 |
| R114 | 315-0153-00 | | RES.,FXD,CMPSN:15K OHM,5%,0.25W | 01121 | CB1535 |
| R116 | 315-0102-00 | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| R118 | 315-0474-00 | | RES.,FXD,CMPSN:470K OHM,5%,0.25W | 01121 | CB4745 |
| R120 | 311-1559-00 | | RES.,VAR,NONWIR:10K OHM,20%,0.50W | 73138 | 91A-10001M |
| R122 | 315-0103-00 | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| R124 | 315-0103-00 | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| R126 | 315-0104-00 | | RES.,FXD,CMPSN:100K OHM,5%,0.25W | 01121 | CB1045 |
| R128 | 315-0475-00 | | RES.,FXD,CMPSN:4.7M OHM,5%,0.25W | 01121 | CB4755 |
| R130 | 311-1134-00 | | RES.,VAR,NONWIR:50K OHM,20%,0.50W | 73138 | 72XW-S1-0-503M |
| R132 | 315-0332-00 | | RES.,FXD,CMPSN:3.3K OHM,5%,0.25W | 01121 | CB3325 |
| R134 | 315-0271-00 | | RES.,FXD,CMPSN:270 OHM,5%,0.25W | 01121 | CB2715 |
| R136 | 315-0106-00 | | RES.,FXD,CMPSN:10M OHM,5%,0.25W | 01121 | CB1065 |
| R138 | 315-0103-00 | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| R140 | 315-0103-00 | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| R142 | 315-0106-00 | | RES.,FXD,CMPSN:10M OHM,5%,0.25W | 01121 | CB1065 |
| R144 | 315-0105-00 | | RES.,FXD,CMPSN:1M OHM,5%,0.25W | 01121 | CB1055 |
| R146 | 315-0106-00 | | RES.,FXD,CMPSN:10M OHM,5%,0.25W | 01121 | CB1065 |
| R148 | 315-0105-00 | | RES.,FXD,CMPSN:1M OHM,5%,0.25W | 01121 | CB1055 |
| R150 | 315-0224-00 | | RES.,FXD,CMPSN:220K OHM,5%,0.25W | 01121 | CB2245 |
| R152 | 315-0103-00 | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| R154 | 315-0182-00 | | RES.,FXD,CMPSN:1.8K OHM,5%,0.25W | 01121 | CB1825 |
| R156 | 315-0103-00 | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| R158 | 315-0103-00 | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| R160 | 315-0102-00 | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| R162 | 315-0681-00 | | RES.,FXD,CMPSN:680 OHM,5%,0.25W | 01121 | CB6815 |
| R164 | 315-0102-00 | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| R166 | 315-0681-00 | | RES.,FXD,CMPSN:680 OHM,5%,0.25W | 01121 | CB6815 |
| R170 | 315-0474-00 | | RES.,FXD,CMPSN:470K OHM,5%,0.25W | 01121 | CB4745 |
| R172 | 315-0101-00 | | RES.,FXD,CMPSN:100 OHM,5%,0.25W | 01121 | CB1015 |
| R174 | 321-0310-00 | | RES.,FXD,FILM:16.5K OHM,1%,0.125W | 91637 | MFF1816G16501F |
| R176 | 315-0203-00 | | RES.,FXD,CMPSN:20K OHM,5%,0.25W | 01121 | CB2035 |
| R180 | 311-1148-00 | | RES.,VAR,NONWIR:100K OHM,20%,0.50W | 32997 | 3386M-T07-104 |
| R182 | 321-0409-00 | | RES.,FXD,FILM:178K OHM,1%,0.125W | 91637 | MFF1816G17802F |
| R184 | 321-0409-00 | | RES.,FXD,FILM:178K OHM,1%,0.125W | 91637 | MFF1816G17802F |
| R185 | 311-1558-00 | | RES.,VAR,NONWIR:20K OHM,20%,0.50W | 73138 | 91A R20K |
| R186 | 321-0409-00 | | RES.,FXD,FILM:178K OHM,1%,0.125W | 91637 | MFF1816G17802F |
| R188 | 315-0103-00 | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |

Replaceable Electrical Parts—SW 503

| Ckt No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---------|--------------------|----------------------|--------|--|----------|-----------------|
| R190 | 315-0472-03 | | | RES., FXD, CMPSN:4.7K OHM, 5%, 0.25W | 01121 | CB4725 |
| R192 | 315-0272-00 | | | RES., FXD, CMPSN:2.7K OHM, 5%, 0.25W | 01121 | CB2725 |
| R194 | 315-0472-03 | | | RES., FXD, CMPSN:4.7K OHM, 5%, 0.25W | 01121 | CB4725 |
| R195 | 311-1558-00 | | | RES., VAR, NONWIR:20K OHM, 20%, 0.50W | 73138 | 91A R20K |
| R196 | 315-0102-00 | | | RES., FXD, CMPSN:1K OHM, 5%, 0.25W | 01121 | CB1025 |
| R200 | 311-1148-00 | | | RES., VAR, NONWIR:100K OHM, 20%, 0.50W | 32997 | 3386M-T07-104 |
| R201 | 315-0124-00 | | | RES., FXD, CMPSN:120K OHM, 5%, 0.25W | 01121 | CB1245 |
| R202 | 315-0102-00 | | | RES., FXD, CMPSN:1K OHM, 5%, 0.25W | 01121 | CB1025 |
| R204 | 315-0224-00 | | | RES., FXD, CMPSN:220K OHM, 5%, 0.25W | 01121 | CB2245 |
| R205 | 311-1148-00 | | | RES., VAR, NONWIR:100K OHM, 20%, 0.50W | 32997 | 3386M-T07-104 |
| R206 | 315-0102-00 | | | RES., FXD, CMPSN:1K OHM, 5%, 0.25W | 01121 | CB1025 |
| R210 | 311-1148-00 | | | RES., VAR, NONWIR:100K OHM, 20%, 0.50W | 32997 | 3386M-T07-104 |
| R211 | 315-0474-02 | | | RES., FXD, CMPSN:470K OHM, 5%, 0.25W | 01121 | CB4745 |
| R212 | 315-0224-00 | | | RES., FXD, CMPSN:220K OHM, 5%, 0.25W | 01121 | CB2245 |
| R213 | 315-0824-00 | | | RES., FXD, CMPSN:820K OHM, 5%, 0.25W | 01121 | CB8245 |
| R214 | 315-0334-00 | | | RES., FXD, CMPSN:330K OHM, 5%, 0.25W | 01121 | CB3345 |
| R215 | 311-1148-00 | | | RES., VAR, NONWIR:100K OHM, 20%, 0.50W | 32997 | 3386M-T07-104 |
| R216 | 315-0474-00 | | | RES., FXD, CMPSN:470K OHM, 5%, 0.25W | 01121 | CB4745 |
| R217 | 315-0183-00 | | | RES., FXD, CMPSN:18K OHM, 5%, 0.25W | 01121 | CB1835 |
| R220 | 315-0753-00 | | | RES., FXD, CMPSN:75K OHM, 5%, 0.25W | 01121 | CB7535 |
| R224 | 315-0103-00 | | | RES., FXD, CMPSN:10K OHM, 5%, 0.25W | 01121 | CB1035 |
| R225 | 311-1558-00 | | | RES., VAR, NONWIR:20K OHM, 20%, 0.50W | 73138 | 91A R20K |
| R230 | 315-0103-00 | | | RES., FXD, CMPSN:10K OHM, 5%, 0.25W | 01121 | CB1035 |
| R232 | 315-0103-00 | | | RES., FXD, CMPSN:10K OHM, 5%, 0.25W | 01121 | CB1035 |
| R234 | 315-0472-03 | | | RES., FXD, CMPSN:4.7K OHM, 5%, 0.25W | 01121 | CB4725 |
| R235 | 311-1559-00 | | | RES., VAR, NONWIR:10K OHM, 20%, 0.50W | 73138 | 91A-10001M |
| R236 | 315-0101-00 | | | RES., FXD, CMPSN:100 OHM, 5%, 0.25W | 01121 | CB1015 |
| R240 | 311-1558-00 | | | RES., VAR, NONWIR:20K OHM, 20%, 0.50W | 73138 | 91A R20K |
| R242 | 315-0103-00 | | | RES., FXD, CMPSN:10K OHM, 5%, 0.25W | 01121 | CB1035 |
| R244 | 315-0103-00 | | | RES., FXD, CMPSN:10K OHM, 5%, 0.25W | 01121 | CB1035 |
| R245 | 311-1558-00 | | | RES., VAR, NONWIR:20K OHM, 20%, 0.50W | 73138 | 91A R20K |
| R246 | 315-0103-00 | | | RES., FXD, CMPSN:10K OHM, 5%, 0.25W | 01121 | CB1035 |
| R247 | 315-0334-00 | | | RES., FXD, CMPSN:330K OHM, 5%, 0.25W | 01121 | CB3345 |
| R250 | 315-0105-00 | | | RES., FXD, CMPSN:1M OHM, 5%, 0.25W | 01121 | CB1055 |
| R252 | 315-0225-00 | | | RES., FXD, CMPSN:2.2M OHM, 5%, 0.25W | 01121 | CB2255 |
| R254 | 315-0684-00 | | | RES., FXD, CMPSN:680K OHM, 5%, 0.25W | 01121 | CB6845 |
| R256 | 315-0102-00 | | | RES., FXD, CMPSN:1K OHM, 5%, 0.25W | 01121 | CB1025 |
| R260 | 315-0102-00 | | | RES., FXD, CMPSN:1K OHM, 5%, 0.25W | 01121 | CB1025 |
| R262 | 321-0343-00 | | | RES., FXD, FILM:36.5K OHM, 1%, 0.125W | 91637 | MFF1816G36501F |
| R264 | 315-0103-00 | | | RES., FXD, CMPSN:10K OHM, 5%, 0.25W | 01121 | CB1035 |
| R266 | 315-0103-00 | | | RES., FXD, CMPSN:10K OHM, 5%, 0.25W | 01121 | CB1035 |
| R267 | 321-0316-00 | | | RES., FXD, FILM:19.1K OHM, 1%, 0.125W | 91637 | MFF1816G19101F |
| R268 | 315-0103-00 | | | RES., FXD, CMPSN:10K OHM, 5%, 0.25W | 01121 | CB1035 |
| R269 | 315-0200-00 | | | RES., FXD, CMPSN:20 OHM, 5%, 0.25W | 01121 | CB2005 |
| R270 | 315-0303-00 | | | RES., FXD, CMPSN:30K OHM, 5%, 0.25W | 01121 | CB3035 |
| R271 | 315-0332-00 | | | RES., FXD, CMPSN:3.3K OHM, 5%, 0.25W | 01121 | CB3325 |
| R272 | 315-0332-00 | | | RES., FXD, CMPSN:3.3K OHM, 5%, 0.25W | 01121 | CB3325 |
| R276 | 315-0752-00 | | | RES., FXD, CMPSN:7.5K OHM, 5%, 0.25W | 01121 | CB7525 |
| R278 | 315-0103-00 | | | RES., FXD, CMPSN:10K OHM, 5%, 0.25W | 01121 | CB1035 |
| R280 | 315-0333-00 | | | RES., FXD, CMPSN:33K OHM, 5%, 0.25W | 01121 | CB3335 |
| R282 | 315-0332-00 | | | RES., FXD, CMPSN:3.3K OHM, 5%, 0.25W | 01121 | CB3325 |
| R284 | 315-0102-00 | | | RES., FXD, CMPSN:1K OHM, 5%, 0.25W | 01121 | CB1025 |
| R288 | 315-0222-00 | | | RES., FXD, CMPSN:2.2K OHM, 5%, 0.25W | 01121 | CB2225 |

| Ckt No. | Tektronix Part No. | Serial/Model No. Eff Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---------|--------------------|-----------------------------|-----------------------------------|----------|-----------------|
| R290 | 315-0153-00 | | RES.,FXD,CMPSN:15K OHM,5%,0.25W | 01121 | CB1535 |
| R292 | 315-0472-03 | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| R294 | 315-0752-00 | | RES.,FXD,CMPSN:7.5K OHM,5%,0.25W | 01121 | CB7525 |
| R296 | 315-0682-00 | | RES.,FXD,CMPSN:6.8K OHM,5%,0.25W | 01121 | CB6825 |
| R298 | 315-0103-00 | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| R300 | 308-0365-00 | | RES.,FXD,WW:1.5 OHM,5%,3W | 56289 | 242EX1R500JQ151 |
| R302 | 315-0472-03 | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| R304 | 315-0472-03 | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| R306 | 315-0103-00 | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| R307 | 315-0822-00 | | RES.,FXD,CMPSN:8.2K OHM,5%,0.25W | 01121 | CB8225 |
| R308 | 301-0560-00 | | RES.,FXD,CMPSN:56 OHM,5%,0.50W | 01121 | EB5605 |
| R309 | 301-0682-00 | | RES.,FXD,CMPSN:6.8K OHM,5%,0.50W | 01121 | EB6825 |
| R310 | 311-1138-00 | | RES.,VAR,NONWIR:1K OHM,20%,0.50W | 73138 | 72XW-44-0-102 |
| R311 | 321-0251-00 | | RES.,FXD,FILM:4.02K OHM,1%,0.125W | 91637 | MFF1816G40200F |
| R312 | 321-0230-00 | | RES.,FXD,FILM:2.43K OHM,1%,0.125W | 91637 | MFF1816G24300F |
| R313 | 321-0289-00 | | RES.,FXD,FILM:10K OHM,1%,0.125W | 91637 | MFF1816G10001F |
| R314 | 301-0560-00 | | RES.,FXD,CMPSN:56 OHM,5%,0.50W | 01121 | EB5605 |
| R316 | 315-0472-03 | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| R317 | 321-0289-00 | | RES.,FXD,FILM:10K OHM,1%,0.125W | 91637 | MFF1816G10001F |
| R318 | 315-0472-03 | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| R321 | 301-0682-00 | | RES.,FXD,CMPSN:6.8K OHM,5%,0.50W | 01121 | EB6825 |
| R322 | 308-0365-00 | | RES.,FXD,WW:1.5 OHM,5%,3W | 56289 | 242EX1R500JQ151 |
| R350 | 311-1558-00 | | RES.,VAR,NONWIR:20K OHM,20%,0.50W | 73138 | 91A R20K |
| R352 | 321-0306-01 | | RES.,FXD,FILM:15K OHM,0.5%,0.125W | 91637 | MFF1816G15001D |
| R354 | 321-0306-01 | | RES.,FXD,FILM:15K OHM,0.5%,0.125W | 91637 | MFF1816G15001D |
| R356 | 315-0103-00 | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| R360 | 315-0153-00 | | RES.,FXD,CMPSN:15K OHM,5%,0.25W | 01121 | CB1535 |
| R362 | 315-0472-00 | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| R364 | 315-0103-00 | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| R370 | 311-1164-00 | | RES.,FXD,NONWIR:50K OHM,20% | 32997 | 3386M-T07-503 |
| R372 | 315-0333-00 | | RES.,FXD,CMPSN:33K OHM,5%,0.25W | 01121 | CB3335 |
| R374 | 315-0271-00 | | RES.,FXD,CMPSN:270 OHM,5%,0.25W | 01121 | CB2715 |
| R375 | ----- | | RESISTOR,VAR:10K OHM | 34280 | RP145-310 |
| R376 | 321-0354-00 | | RES.,FXD,FILM:47.5K OHM,1%,0.125W | 91637 | MFF1816G47501F |
| R378 | 315-0474-00 | | RES.,FXD,CMPSN:470K OHM,5%,0.25W | 01121 | CB4745 |
| R380 | 315-0475-00 | | RES.,FXD,CMPSN:4.7M OHM,5%,0.25W | 01121 | CB4755 |
| R381 | 316-0476-00 | | RES.,FXD,CMPSN:47M OHM,10%,0.25W | 01121 | CB4761 |
| R382 | 315-0104-00 | | RES.,FXD,CMPSN:100K OHM,5%,0.25W | 01121 | CB1045 |
| R383 | 315-0393-00 | | RES.,FXD,CMPSN:39K OHM,5%,0.25W | 01121 | CB3935 |
| R384 | 315-0107-00 | | RES.,FXD,CMPSN:100M OHM,5%,0.25W | 01121 | CB1075 |
| R386 | 315-0472-00 | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| R390 | 315-0473-00 | | RES.,FXD,CMPSN:47K OHM,5%,0.25W | 01121 | CB4735 |
| R392 | 315-0473-00 | | RES.,FXD,CMPSN:47K OHM,5%,0.25W | 01121 | CB4735 |
| R394 | 321-0300-00 | | RES.,FXD,FILM:13K OHM,1%,0.125W | 91637 | MFF1816G13001F |
| R396 | 315-0104-00 | | RES.,FXD,CMPSN:100K OHM,5%,0.25W | 01121 | CB1045 |
| R398 | 315-0106-00 | | RES.,FXD,CMPSN:10M OHM,5%,0.25W | 01121 | CB1065 |
| R400 | 315-0103-00 | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| R401 | 315-0105-00 | | RES.,FXD,CMPSN:1M OHM,5%,0.25W | 01121 | CB1055 |
| R402 | 321-0351-00 | | RES.,FXD,FILM:44.2K OHM,1%,0.125W | 91637 | MFF1816G44201F |
| R404 | 315-0224-00 | | RES.,FXD,CMPSN:220K OHM,5%,0.25W | 01121 | CB2245 |
| R405 | 311-1558-00 | | RES.,VAR,NONWIR:20K OHM,20%,0.50W | 73138 | 91A R20K |
| R406 | 315-0472-00 | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| R408 | 315-0472-00 | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |

Replaceable Electrical Parts—SW 503

| Ckt No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---------|--------------------|----------------------|--------|--|----------|-----------------|
| R410 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| R412 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| R414 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| R416 | 315-0105-00 | | | RES.,FXD,CMPSN:1M OHM,5%,0.25W | 01121 | CB1055 |
| R420 | 315-0104-00 | | | RES.,FXD,CMPSN:100K OHM,5%,0.25W | 01121 | CB1045 |
| R422 | 315-0104-00 | | | RES.,FXD,CMPSN:100K OHM,5%,0.25W | 01121 | CB1045 |
| R424 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| R426 | 315-0223-00 | | | RES.,FXD,CMPSN:22K OHM,5%,0.25W | 01121 | CB2235 |
| R428 | 315-0223-00 | | | RES.,FXD,CMPSN:22K OHM,5%,0.25W | 01121 | CB2235 |
| R430 | 315-0106-00 | | | RES.,FXD,CMPSN:10M OHM,5%,0.25W | 01121 | CB1065 |
| R432 | 315-0273-00 | | | RES.,FXD,CMPSN:27K OHM,5%,0.25W | 01121 | CB2735 |
| R435 | 311-1164-00 | | | RES.,FXD,NONWIR:50K OHM,20% | 32997 | 3386M-T07-503 |
| R435 | 311-1246-00 | | | RES.,VAR,CMPSN:10K OHM,10%,0.50W | 02111 | 63X-503-T602 |
| R436 | 315-0203-00 | | | RES.,FXD,CMPSN:20K OHM,5%,0.25W | 01121 | CB2035 |
| R438 | 315-0683-00 | | | RES.,FXD,CMPSN:68K OHM,5%,0.25W | 01121 | CB6835 |
| R440 | 315-0104-00 | | | RES.,FXD,CMPSN:100K OHM,5%,0.25W | 01121 | CB1045 |
| R442 | 315-0104-00 | | | RES.,FXD,CMPSN:100K OHM,5%,0.25W | 01121 | CB1045 |
| R444 | 315-0106-00 | | | RES.,FXD,CMPSN:10M OHM,5%,0.25W | 01121 | CB1065 |
| R446 | 315-0104-00 | | | RES.,FXD,CMPSN:100K OHM,5%,0.25W | 01121 | CB1045 |
| R448 | 315-0472-00 | | | RES.,FXD,CMPSN:4.7K OHM,5%,0.25W | 01121 | CB4725 |
| R450 | 315-0104-00 | | | RES.,FXD,CMPSN:100K OHM,5%,0.25W | 01121 | CB1045 |
| R460 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| R461 | 315-0563-00 | | | RES.,FXD,CMPSN:56K OHM,5%,0.25W | 01121 | CB5635 |
| R462 | 315-0102-00 | | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| R464 | 315-0473-00 | | | RES.,FXD,CMPSN:47K OHM,5%,0.25W | 01121 | CB4735 |
| R470 | 315-0104-00 | | | RES.,FXD,CMPSN:100K OHM,5%,0.25W | 01121 | CB1045 |
| R472 | 315-0103-00 | | | RES.,FXD,CMPSN:10K OHM,5%,0.25W | 01121 | CB1035 |
| R474 | 315-0104-00 | | | RES.,FXD,CMPSN:100K OHM,5%,0.25W | 01121 | CB1045 |
| R476 | 315-0473-00 | | | RES.,FXD,CMPSN:47K OHM,5%,0.25W | 01121 | CB4735 |
| R500 | 321-0306-00 | | | RES.,FXD,FILM:15K OHM,1%,0.125W | 91637 | MFF1816G15001F |
| R502 | 321-0289-00 | | | RES.,FXD,FILM:10K OHM,1%,0.125W | 91637 | MFF1816G10001F |
| R504 | 321-0176-00 | | | RES.,FXD,FILM:665 OHM,1%,0.125W | 91637 | MFF1816G665R0F |
| R505 | 118-0067-00 | | | RESISTOR,VAR:10K OHM,5.5MM SHAFT | 80009 | 118-0067-00 |
| R510 | 118-0068-00 | | | RESISTOR,VAR:10K OHM,5.5MM SHAFT | 80009 | 118-0068-00 |
| R512 | 315-0153-00 | | | RES.,FXD,CMPSN:15K OHM,5%,0.25W | 01121 | CB1535 |
| R514 | 315-0102-00 | | | RES.,FXD,CMPSN:1K OHM,5%,0.25W | 01121 | CB1025 |
| S360 | 118-0053-00 | | | DOT MKR SWP AS: | 80009 | 118-0053-00 |
| S370 | 118-0053-00 | | | DOT MKR SWP AS: | 80009 | 118-0053-00 |
| S372 | 118-0053-00 | | | DOT MKR SWP AS: | 80009 | 118-0053-00 |
| S500 | 118-0052-00 | | | CKT CARD ASSY:ATTEN BRKT AND MARKER | 80009 | 118-0052-00 |
| S502 | 118-0052-00 | | | CKT CARD ASSY:ATTEN BRKT AND MARKER | 80009 | 118-0052-00 |
| S504 | 118-0052-00 | | | CKT CARD ASSY:ATTEN BRKT AND MARKER | 80009 | 118-0052-00 |
| S510 | 118-0052-00 | | | CKT CARD ASSY:ATTEN BRKT AND MARKER | 80009 | 118-0052-00 |
| S512 | 118-0052-00 | | | CKT CARD ASSY:ATTEN BRKT AND MARKER | 80009 | 118-0052-00 |
| S514 | 118-0052-00 | | | CKT CARD ASSY:ATTEN BRKT AND MARKER | 80009 | 118-0052-00 |
| S516 | 118-0052-00 | | | CKT CARD ASSY:ATTEN BRKT AND MARKER | 80009 | 118-0052-00 |
| U150 | 156-0742-00 | | | MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER | 80009 | 156-0742-00 |
| U210A | 156-0158-00 | | | MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER | 80009 | 156-0158-00 |
| U210B | 156-0158-00 | | | MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER | 80009 | 156-0158-00 |
| U230A | 156-0158-00 | | | MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER | 80009 | 156-0158-00 |
| U230B | 156-0158-00 | | | MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER | 80009 | 156-0158-00 |
| U250A | 156-0158-00 | | | MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER | 80009 | 156-0158-00 |

| Ckt No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Name & Description | Mfr Code | Mfr Part Number |
|---------|--------------------|----------------------|--------|--|----------|-----------------|
| U250B | 156-0158-00 | | | MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER | 80009 | 156-0158-00 |
| U280A | 156-0158-00 | | | MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER | 80009 | 156-0158-00 |
| U280B | 156-0158-00 | | | MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER | 80009 | 156-0158-00 |
| U325 | 156-0277-00 | | | MICROCIRCUIT,LI:VOLTAGE REGULATOR | 27014 | LM340T-5 |
| U390 | 156-0067-00 | | | MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER | 80009 | 156-0067-00 |
| U410A,B | 156-0158-00 | | | MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER | 80009 | 156-0158-00 |
| VR304 | 152-0309-00 | | | SEMICOND DEVICE:ZENER,1W,6.2V,5% | 04713 | 1N3828A |
| VR308 | 152-0278-00 | | | SEMICOND DEVICE:ZENER,0.4W,3V,5% | 07910 | 1N4372A |
| VR320 | 152-0278-00 | | | SEMICOND DEVICE:ZENER,0.4W,3V,5% | 07910 | 1N4372A |

OPTIONS

OPTION 1

Option 1 is described throughout the manual where appropriate.

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).

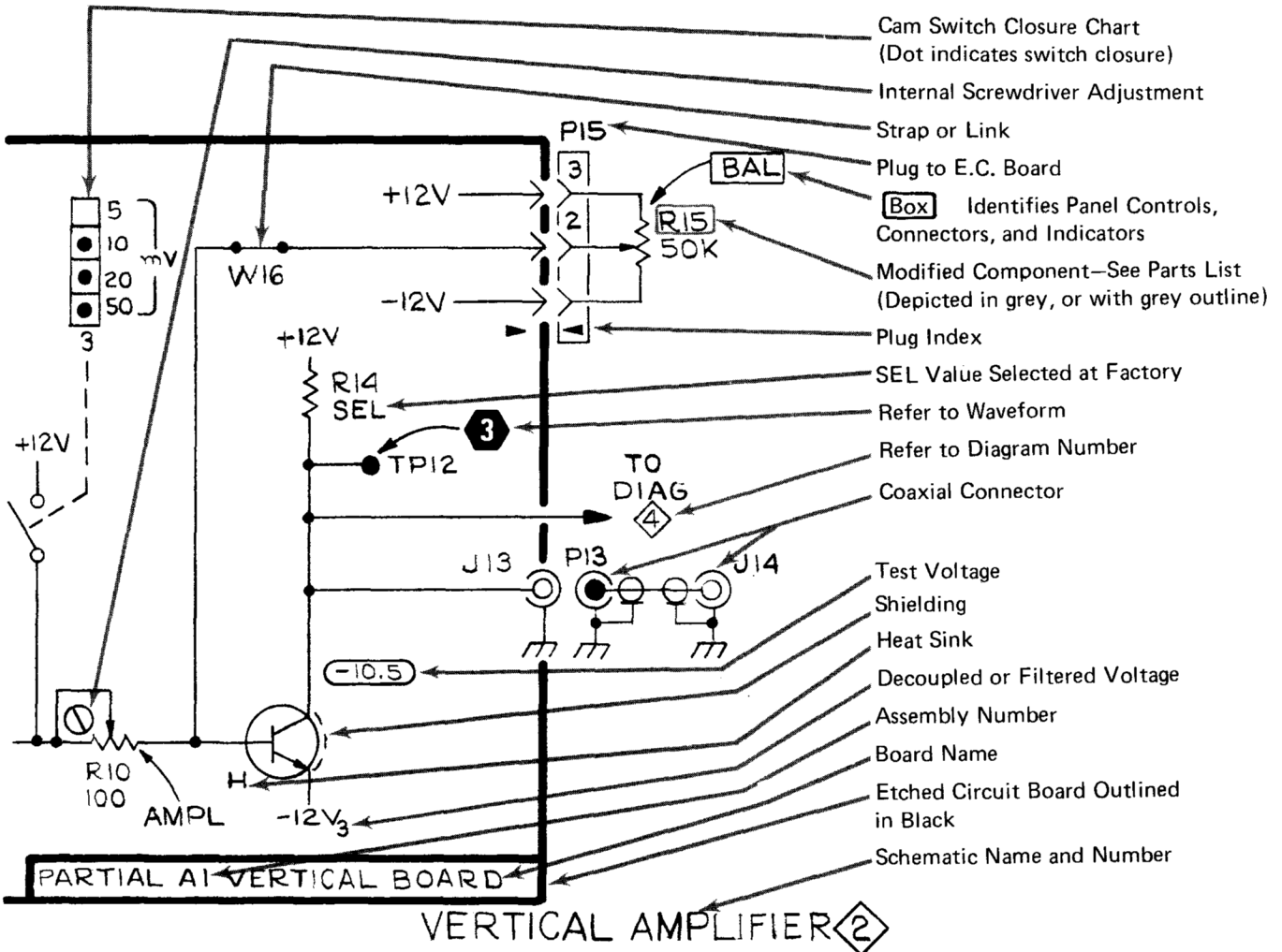
Symbols used on the diagrams are based on ANSI Standard Y32.2-1975.

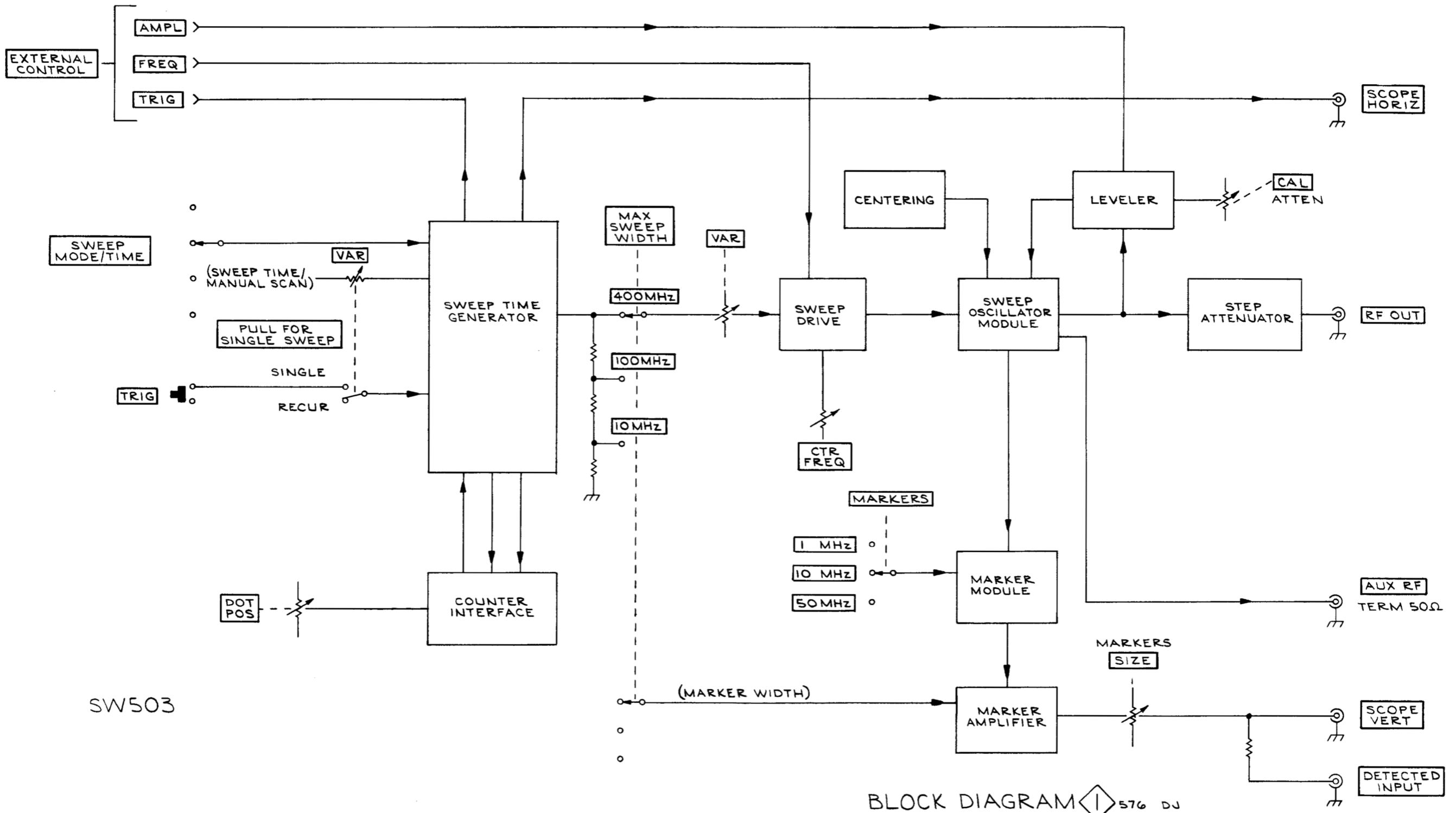
Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

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 | R | Resistor, fixed or variable | Z | Phase shifter |
| F | Fuse | RT | Thermistor | | |
| FL | Filter | | | | |

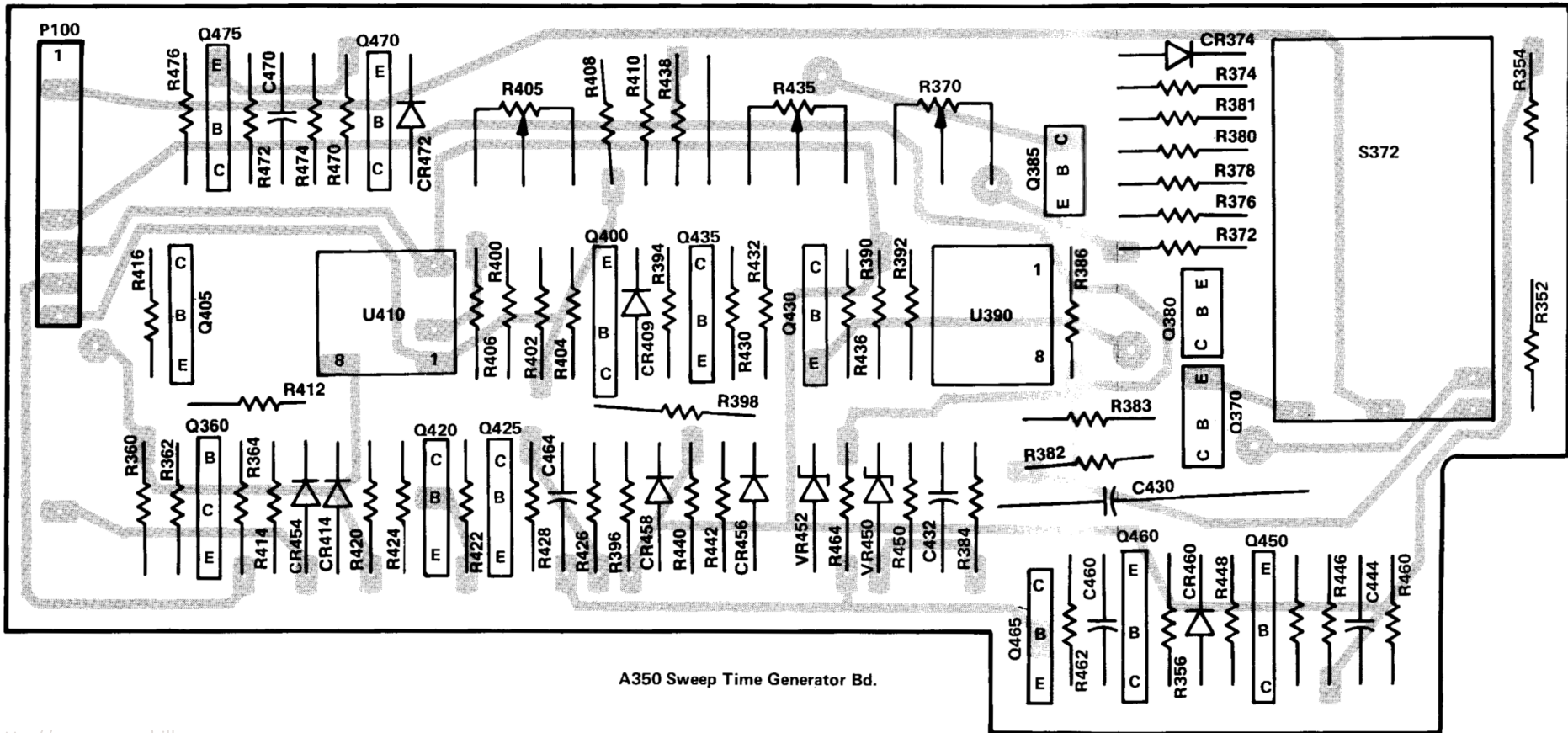
The following special symbols are used on the diagrams:

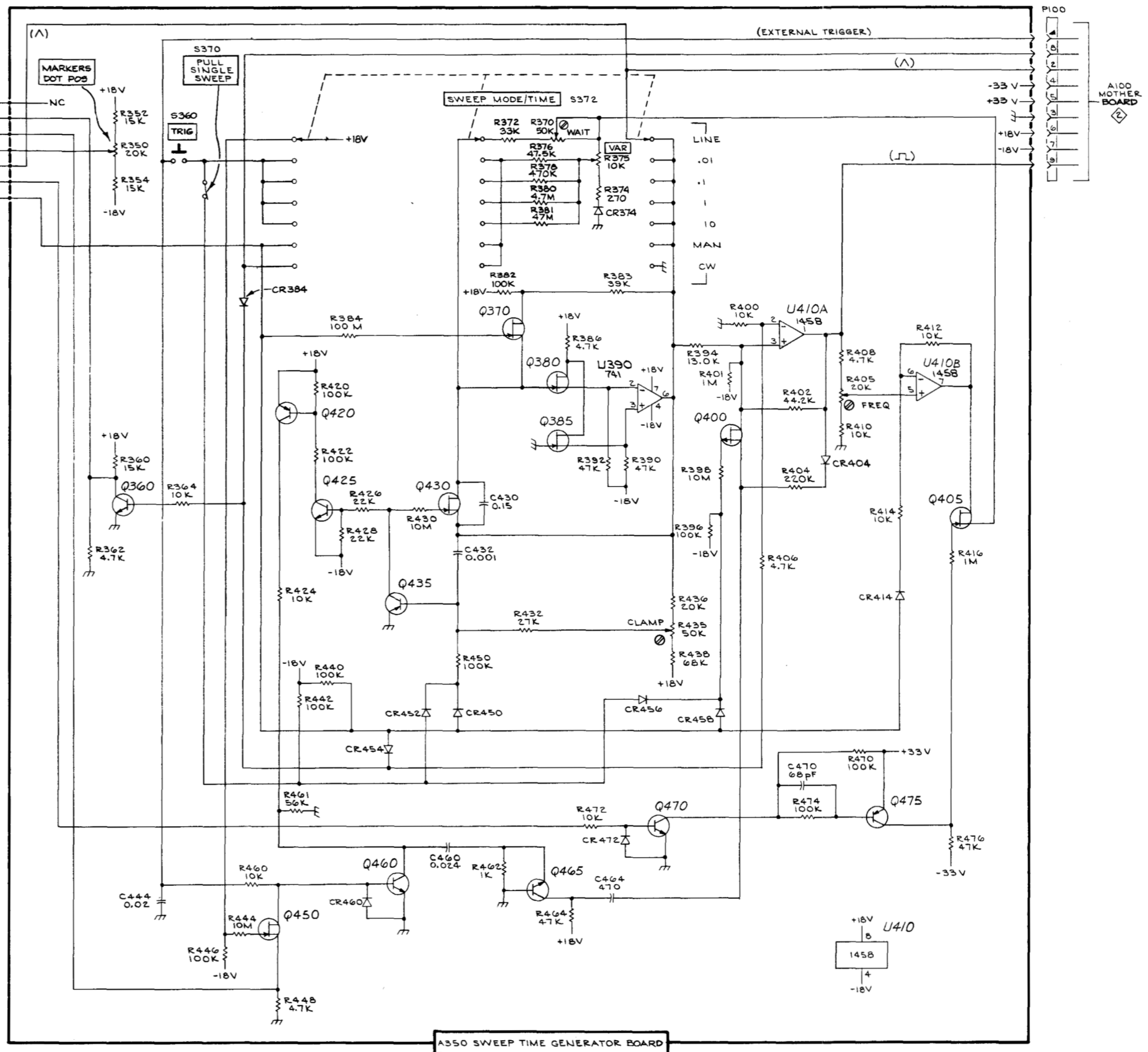
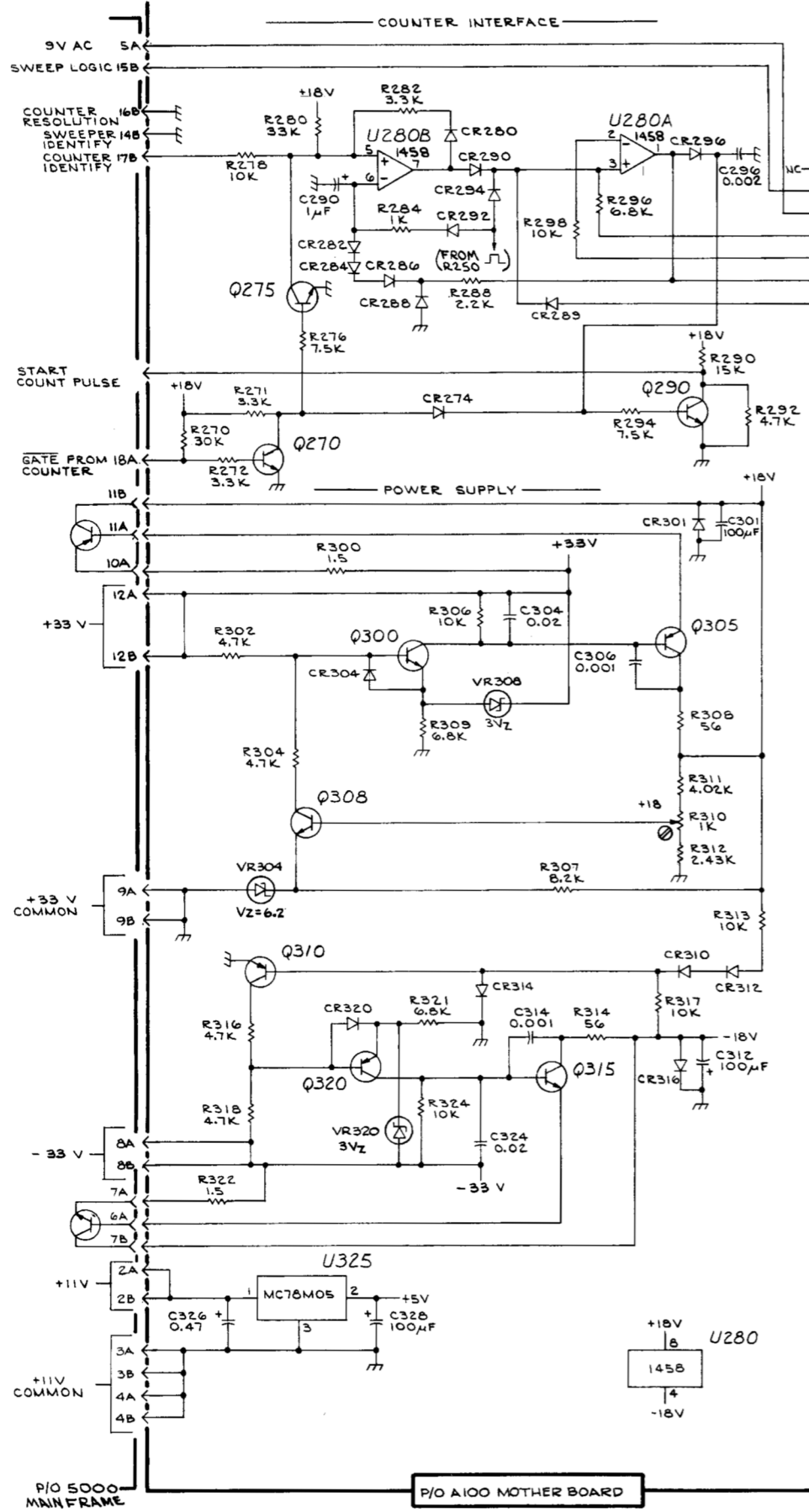




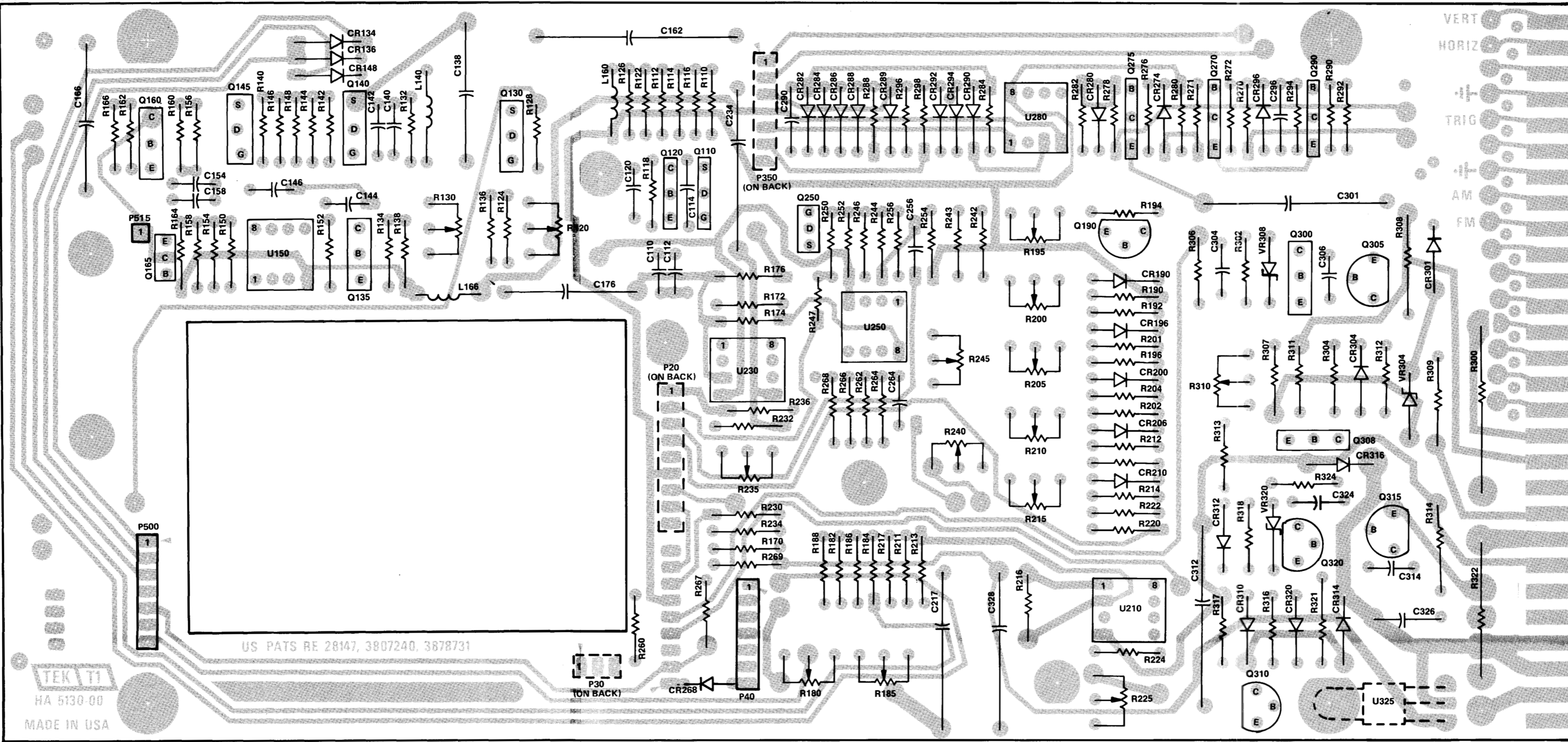
SW503

BLOCK DIAGRAM 1 576 DJ





SWEEP TIME GENERATOR, POWER SUPPLY & COUNTER INTERFACE

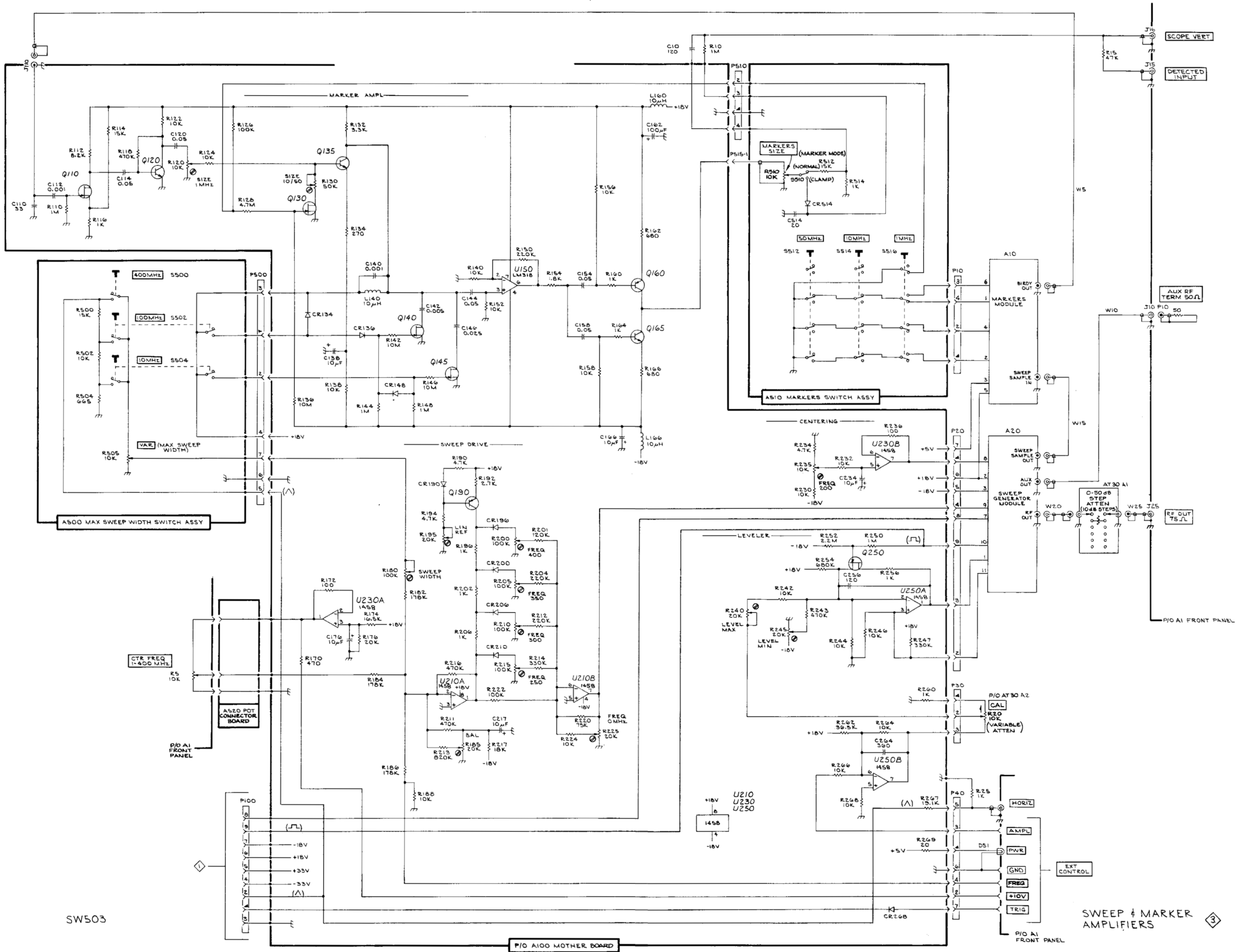


VERT
HORIZ
TRIG
AM
FM

US PATS RE 28147, 3807240, 3878731

TEK T1
HA 5130-00
MADE IN USA

A100 Main Circuits Bd.



SW503

SWEEP & MARKER AMPLIFIERS

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 | ELECTRN | ELECTRON | IN | INCH | SE | SINGLE END |
| # | NUMBER SIZE | ELEC | ELECTRICAL | INCAND | INCANDESCENT | SECT | SECTION |
| ACTR | ACTUATOR | ELECTLT | 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

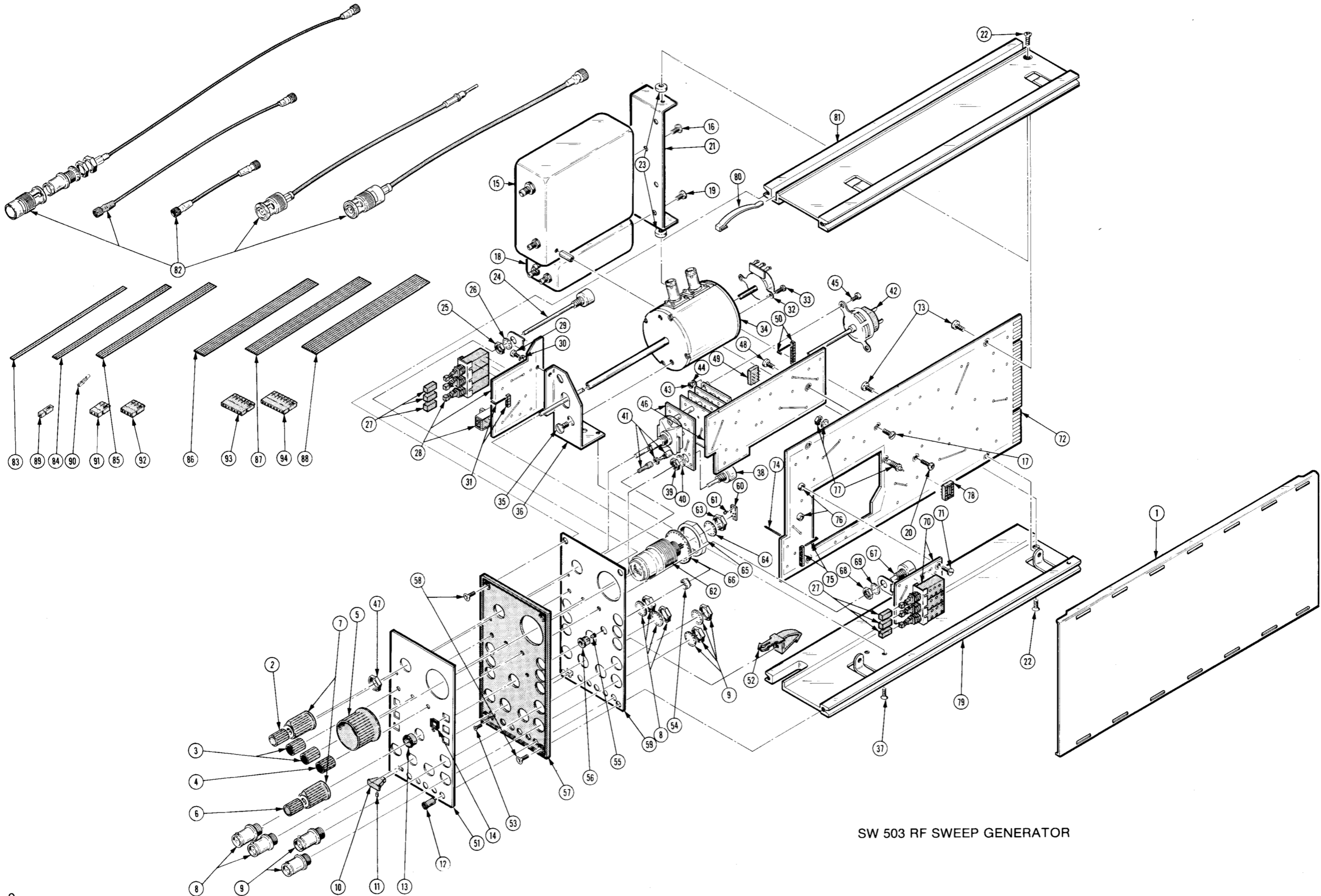
| Mfr. Code | Manufacturer | Address | City, State, Zip |
|-----------|---|-------------------------------|----------------------------|
| 00779 | AMP, INC. | P O BOX 3608 | HARRISBURG, PA 17105 |
| | NO ENTRY FOR 05009 | | |
| 05091 | TRI-ORDINATE CORPORATION | 343 SNYDER AVENUE | BERKELEY HEIGHTS, NJ 07922 |
| 08261 | SPECTRA-STRIP CORP. | 7100 LAMPSON AVE. | GARDEN GROVE, CA 92642 |
| 12327 | FREEWAY CORPORATION | 9301 ALLEN DRIVE | CLEVELAND, OH 44125 |
| 22526 | BERG ELECTRONICS, INC. | YOUK EXPRESSWAY | NEW CUMBERLAND, PA 17070 |
| 32997 | BOURNS, INC., TRIMPOT PRODUCTS DIV. | 1200 COLUMBIA AVE. | RIVERSIDE, CA 92507 |
| 34280 | WAVETEK INDIANA, INC. | PO BOX 190, 66N FIRST AVENUE | BEECH GROVE, IN 46107 |
| 45722 | USM CORP., PARKER-KALON FASTENER DIV. | | CAMPBELLSVILLE, KY 42718 |
| 71159 | BRISTOL SOCKET SCREW, DIV. OF AMERICAN CHAIN AND CABLE CO., INC. | P O BOX 2244, 40 BRISTOL ST. | WATERBURY, CT 06720 |
| 71279 | CAMBRIDGE THERMIONIC CORP. | 445 CONCORD AVE. | CAMBRIDGE, MA 02138 |
| 73743 | FISCHER SPECIAL MFG. CO. | 446 MORGAN ST. | CINCINNATI, OH 45206 |
| 73803 | TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV. | 34 FOREST STREET | ATTLEBORO, MA 02703 |
| 74445 | HOLO-KROME CO. | 31 BROOK ST. WEST | HARTFORD, CT 06110 |
| 78189 | ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION | ST. CHARLES ROAD | ELGIN, IL 60120 |
| 80009 | TEKTRONIX, INC. | P O BOX 500 | BEAVERTON, OR 97077 |
| 81073 | GRAYHILL, INC. | 561 HILGROVE AVE., PO BOX 373 | LA GRANGE, IL 60525 |
| 83385 | CENTRAL SCREW CO. | 2530 CRESCENT DR. | BROADVIEW, IL 60153 |
| 91836 | KINGS ELECTRONICS CO., INC. | 40 MARBLEDALE ROAD | TUCKAHOE, NY 10707 |

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff Dscont | Qty | 1 2 3 4 5 | Name & Description | Mfr Code | Mfr Part Number |
|------------------|--------------------|-----------------------------|-----|-----------|--|----------|------------------|
| 1-1 | 337-1399-00 | | 2 | | SHLD,ELECTRICAL:SIDE | 80009 | 337-1399-00 |
| -2 | 366-1031-02 | B010100 B010299 | 1 | | KNOB:RED-VAR | 80009 | 366-1031-02 |
| | 366-1031-06 | B010300 | 1 | | KNOB:GRAY--VAR | 80009 | 366-1031-06 |
| | 213-0153-00 | | 1 | | . SETSCREW:5-40 X 0.125 INCH,HEX SOC STL | 74445 | OBD |
| -3 | 366-1023-01 | B010100 B010299 | 2 | | KNOB:GRAY | 80009 | 366-1023-01 |
| | 366-1023-07 | B010300 | 2 | | KNOB:GRAY,0.127 ID,0.392 OD,0.466 | 80009 | 366-1023-07 |
| | ----- | | - | | . EACH KNOB INCLUDES: | | |
| | 213-0246-00 | | 1 | | . SETSCREW:5-40 X 0.093 INCH L,HEX SOC | 71159 | OBD |
| -4 | 366-1023-02 | B010100 B010299 | 1 | | KNOB:GRAY--VAR | 80009 | 366-1023-02 |
| | 366-1023-09 | B010300 | 1 | | KNOB:GRAY--VAR | 80009 | 366-1023-09 |
| | 213-0246-00 | | 1 | | . SETSCREW:5-40 X 0.093 INCH L,HEX SOC | 71159 | OBD |
| -5 | 366-1269-00 | | 1 | | KNOB:GRAY,1-500 | 80009 | 366-1269-00 |
| -6 | 366-1031-03 | B010100 B010299 | 1 | | KNOB:RED--CAL | 80009 | 366-1031-03 |
| | 366-1464-02 | B010300 | 1 | | KNOB:GRAY--CAL | 80009 | 366-1464-02 |
| | 213-0153-00 | | 1 | | . SETSCREW:5-40 X 0.125 INCH,HEX SOC STL | 74445 | OBD |
| -7 | 366-1165-00 | B010100 B010299 | 2 | | KNOB:GRAY | 80009 | 366-1165-00 |
| | 366-1165-01 | B010300 | 2 | | KNOB:GRAY,0.252 ID,0.706 OD,0.65 H | 80009 | 366-1165-01 |
| | ----- | | - | | . EACH KNOB INCLUDES: | | |
| | 213-0153-00 | | 2 | | . SETSCREW:5-40 X 0.125 INCH,HEX SOC STL | 74445 | OBD |
| -8 | 131-0818-00 | | 2 | | CONNECTOR,RCPT,:BNC,FEMALE | 91836 | KC19-153BNC |
| -9 | 131-0955-00 | | 3 | | CONNECTOR,RCPT,:BNC,FEMALE,W/HARDWARE | 05091 | 31-279 |
| -10 | 366-1520-02 | | 1 | | KNOB:GRAY | 80009 | 366-1520-02 |
| | | | | | (ATTACHING PARTS) | | |
| -11 | 214-1840-00 | | 1 | | PIN,KNOB SECRG:0.094 OD X 0.120 INCH LONG | 80009 | 214-1840-00 |
| | | | | | -----* | | |
| -12 | 136-0387-00 | | 5 | | JACK,TIP:GRAY | 71279 | 4352-1-0318 |
| -13 | 348-0067-00 | | 1 | | GROMMET,PLASTIC:0.312 INCH DIA | 80009 | 348-0067-00 |
| -14 | 426-1072-00 | | 6 | | FRAME,PUSH BTN:PLASTIC | 80009 | 426-1072-00 |
| -15 | 118-0056-00 | | 1 | | MODULE,SWEEP:75 OHM | 80009 | 118-0056-00 |
| | 118-0057-00 | | 1 | | MODULE,SWEEP:50 OHM | 80009 | 118-0057-00 |
| | | | | | (ATTACHING PARTS) | | |
| -16 | 211-0507-00 | | 1 | | SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL | 83385 | OBD |
| -17 | 211-0007-00 | | 1 | | SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL | 83385 | OBD |
| | | | | | -----* | | |
| -18 | 118-0058-00 | | 1 | | MODULE,MARKER: | 80009 | 118-0058-00 |
| | | | | | (ATTACHING PARTS) | | |
| -19 | 211-0507-00 | | 1 | | SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL | 83385 | OBD |
| -20 | 211-0007-00 | | 1 | | SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL | 83385 | OBD |
| | | | | | -----* | | |
| -21 | 118-0051-00 | | 1 | | BRACKET,MODULE: | 80009 | 118-0051-00 |
| | | | | | (ATTACHING PARTS) | | |
| -22 | 211-0559-00 | | 2 | | SCREW,MACHINE:6-32 X 0.375"100 DEG,FLH STL | 83385 | OBD |
| -23 | 361-0122-00 | | 2 | | SPACER,SLEEVE:0.125 L X 0.12 ID BRS | 80009 | 361-0122-00 |
| | | | | | -----* | | |
| -24 | 118-0068-00 | | 1 | | RESISTOR,VAR:10K OHM,5.5MM SHAFT | 80009 | 118-0068-00 |
| | | | | | (ATTACHING PARTS) | | |
| -25 | 210-0583-00 | | 1 | | NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS | 73743 | 2X20224-402 |
| -26 | 210-0046-00 | | 1 | | WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL | 78189 | 1214-05-00-0541C |
| | | | | | -----* | | |
| -27 | 366-1559-00 | | 6 | | PUSH BUTTON:GRAY | 80009 | 366-1559-00 |
| -28 | 118-0052-00 | | 1 | | CKT CARD ASSY:ATTEN BRKT AND MARKER | 80009 | 118-0052-00 |
| | | | | | (ATTACHING PARTS) | | |
| -29 | 211-0007-00 | | 2 | | SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL | 83385 | OBD |
| -30 | 210-0802-00 | | 2 | | WASHER,FLAT:0.15 ID X 0.312 INCH OD | 12327 | OBD |
| | | | | | -----* | | |
| | ----- | | - | | . CKT BOARD ASSY INCLUDES: | | |
| -31 | 131-1426-00 | | 1 | | . CONTACT SET,ELE:R ANGLE,0.250L,STRIP OF 36 | 22526 | 65524-436 |
| -32 | ----- | | 1 | | RESISTOR,VAR:10K OHM | 34280 | RP146-310 |
| | | | | | (ATTACHING PARTS) | | |
| -33 | 211-0008-00 | | 2 | | SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL | 83385 | OBD |
| | | | | | -----* | | |
| -34 | 118-0054-00 | | 1 | | ATTENUATOR,VAR:75 OHM | 34280 | 7550-2 |

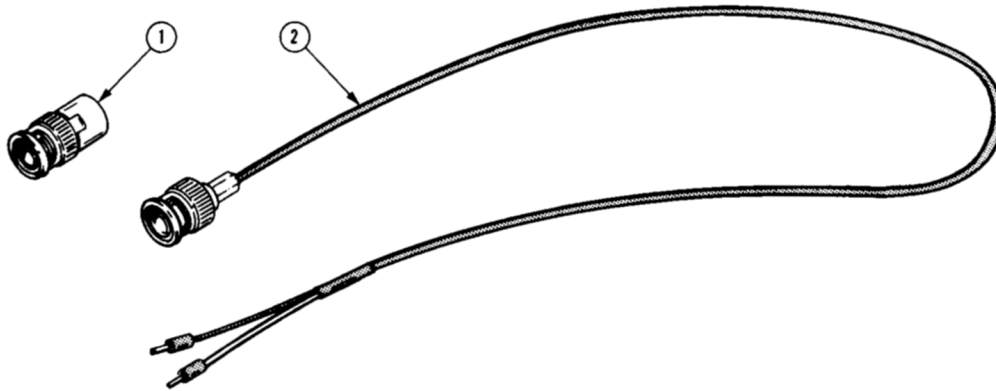
Replaceable Mechanical Parts—SW 503

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff Dscont | Qty | 1 2 3 4 5 | Name & Description | Mfr Code | Mfr Part Number |
|------------------|--------------------|-----------------------------|-----|-----------|--|----------|------------------|
| 1- | 118-0055-00 | | 1 | | ATTENUATOR,VAR:50 OHM (ATTACHING PARTS) | 34280 | A600-013-0Z |
| -35 | 212-0004-00 | | 2 | | SCREW,MACHINE:8-32 X 0.312 INCH,PNH STL - - - * - - - | 83385 | OBD |
| -36 | 118-0066-00 | | 1 | | BRACKET,ATTEN:L-SHAPED (ATTACHING PARTS) | 80009 | 118-0066-00 |
| -37 | 211-0541-00 | | 2 | | SCREW,MACHINE:6-32 X 0.25"100 DEG,FLH STL - - - * - - - | 83385 | OBD |
| -38 | 118-0069-00 | | 1 | | RESISTOR,VAR:10K OHM,2MM SHAFT (ATTACHING PARTS) | 80009 | 118-0069-00 |
| -39 | 210-0583-00 | | 1 | | NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS | 73743 | 2X20224-402 |
| -40 | 210-0046-00 | | 1 | | WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL - - - * - - - | 78189 | 1214-05-00-0541C |
| -41 | 260-0735-00 | | 1 | | SWITCH,PUSH:SPST | 81073 | 39-1 |
| -42 | ----- | | 1 | | RESISTOR,VAR:10K OHM (ATTACHING PARTS) | 34280 | RP145-310 |
| -43 | 210-0406-00 | | 2 | | NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS | 73743 | 2X12161-402 |
| -44 | 210-0004-00 | | 2 | | WASHER,LOCK:INTL,0.12 ID X 0.26"OD,STL | 78189 | 1204-00-00-0541C |
| -45 | 211-0014-00 | | 2 | | SCREW,MACHINE:4-40 X 0.50 INCH,PNH STL - - - * - - - | 83385 | OBD |
| -46 | 118-0053-00 | | 1 | | DOT MKR SWP AS: (ATTACHING PARTS) | 80009 | 118-0053-00 |
| -47 | 210-0413-00 | | 1 | | NUT,PLAIN,HEX.:0.375-32 X 0.50 INCH,STL | 73743 | 3145-402 |
| -48 | 211-0008-00 | | 1 | | SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL - - - * - - - | 83385 | OBD |
| -49 | 136-0514-00 | | 2 | | . DOT MARKER SWP ASSY INCLUDES: . SOCKET,PLUG IN:MICROCIRCUIT,8 CONTACT | 73803 | C9308-02 |
| -50 | 131-1426-00 | | 1 | | . CONTACT SET,ELE:R ANGLE,0.250L,STRIP OF 36 | 22526 | 65524-436 |
| -51 | 333-2187-00 | B010100 B010299 | 1 | | PANEL,FRONT: | 80009 | 333-2187-00 |
| | 333-2187-01 | B010300 | 1 | | PANL,FRONT: | 80009 | 333-2187-01 |
| | 333-2186-00 | B010100 B010299 | 1 | | PANEL FRONT:OPTION 1 ONLY | 80009 | 333-2186-00 |
| | 333-2186-01 | B010300 | 1 | | PANEL,FRONT:OPTION 1 ONLY | 80009 | 333-2186-01 |
| -52 | 214-1513-01 | | 1 | | LCH,PLUG-IN RET: (ATTACHING PARTS) | 80009 | 214-1513-01 |
| -53 | 213-0254-00 | | 1 | | SCR,TPG,THD CTG:2-32 X 0.250,100 DEG,FLH - - - * - - - | 45722 | OBD |
| -54 | 200-0935-00 | | 1 | | BASE,LAMPHOLDER:0.29 OD X 0.19 CASE | 80009 | 200-0935-00 |
| -55 | 378-0602-00 | | 1 | | LENS,LIGHT:GREEN | 80009 | 378-0602-00 |
| -56 | 352-0157-00 | | 1 | | LAMPHOLDER:WHITE PLASTIC | 80009 | 352-0157-00 |
| -57 | 386-3583-00 | B010100 B010299 | 1 | | SUBPANEL,FRONT: | 80009 | 386-3583-00 |
| | 386-3583-01 | B010300 | 1 | | SUBPANEL,FRONT: (ATTACHING PARTS) | 80009 | 386-3583-01 |
| -58 | 213-0229-00 | | 4 | | SCR,TPG,THD FOR:6-20 X0.375"100 DEG,FLH STL - - - * - - - | 83385 | OBD |
| -59 | 337-2352-00 | B010100 B010299 | 1 | | SHIELD,ELEC:FRONT PANEL | 80009 | 337-2352-00 |
| | 337-2352-01 | B010300 | 1 | | SHIELD,ELEC:FRONT PANEL | 80009 | 337-2352-01 |
| -60 | 388-1704-00 | | 1 | | CIRCUIT BOARD:RESISTANCE SOCKET | 80009 | 388-1704-00 |
| -61 | 136-0261-00 | | 3 | | SOCKET,PIN TERM:FOR 0.22 INCH PIN | 00779 | 1-331677-6 |
| -62 | 118-0084-00 | | 1 | | RES.,VAR,WW:10K OHM,5%,1.5W (ATTACHING PARTS) | 32997 | 3610S-534-103 |
| -63 | 210-0413-00 | | 1 | | NUT,PLAIN,HEX.:0.375-32 X 0.50 INCH,STL | 73743 | 3145-402 |
| -64 | 210-0021-00 | | 1 | | WASHER,LOCK:INTL,0.476 ID X 0.60"OD STL | 78189 | 1222-01-00-0541C |
| -65 | 220-0459-00 | | 1 | | NUT,PLAIN,DODEC: | 73743 | 2XX-64066-101 |
| -66 | 210-0047-00 | | 1 | | WASHER,LOCK:0.88 ID X 1.110 OD - - - * - - - | 78189 | 1234-04-00-0541C |
| -67 | 118-0067-00 | | 1 | | RESISTOR,VAR:10K OHM,14.5MM SHAFT (ATTACHING PARTS) | 80009 | 118-0067-00 |
| -68 | 210-0583-00 | | 1 | | NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS | 73743 | 2X20224-402 |
| -69 | 210-0046-00 | | 1 | | WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL - - - * - - - | 78189 | 1214-05-00-0541C |
| -70 | 118-0062-00 | | 1 | | CKT BOARD ASSY:SWEEP WIDTH (ATTACHING PARTS) | 80009 | 118-0062-00 |
| -71 | 211-0008-00 | | 2 | | SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL - - - * - - - | 83385 | OBD |

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff Dscnt | Qty | 1 | 2 | 3 | 4 | 5 | Name & Description | Mfr Code | Mfr Part Number |
|------------------|--------------------|----------------------------|-----|---|---|---|---|---|--|----------|------------------|
| 1-72 | 118-0059-00 | | 1 | | | | | | CKT BOARD ASSY:MAIN (ATTACHING PARTS) | 80009 | 118-0059-00 |
| -73 | 211-0503-00 | | 4 | | | | | | SCREW,MACHINE:6-32 X 0.188 INCH,PNH STL - - - * - - - | 83385 | OBD |
| | ----- | | - | | | | | | . CKT BOARD ASSY INCLUDES: | | |
| -74 | 131-0608-00 | | 4 | | | | | | . CONTACT,ELEC:0.365 L X 0.25 PH BRZ GOLD PL | 22526 | 47357 |
| -75 | 131-1426-00 | | 1 | | | | | | . CONTACT SET,ELE:R ANGLE,0.250L,STRIP OF 36 | 22526 | 65524-436 |
| -76 | 129-0320-00 | | 2 | | | | | | . POST,ELEC-MECH:0.187 OD X 0.15 INCH LONG | 80009 | 129-0120-00 |
| -77 | 131-1505-00 | | 1 | | | | | | . CONN,RCPT,ELEC: | 05009 | 0500430149220 |
| -78 | 136-0514-00 | | 5 | | | | | | . SOCKET,PLUG IN:MICROCIRCUIT,8 CONTACT | 73803 | C9308-02 |
| -79 | 118-0063-00 | | 1 | | | | | | FR SECT,PLUG-IN:BOTTOM | 34280 | C900-232 BOTTOM |
| -80 | 214-1061-00 | | 1 | | | | | | SPRING,GROUND:FLAT | 80009 | 214-1061-00 |
| -81 | 118-0064-00 | | 1 | | | | | | FR SECT,PLUG-IN:TOP | 34280 | C900-232 TOP |
| -82 | 118-0060-00 | | 1 | | | | | | WIRE SET,ELEC:50 OHM | 80009 | 118-0060-00 |
| | 118-0061-00 | | 1 | | | | | | WIRE SET,ELEC:75 OHM | 80009 | 118-0061-00 |
| -83 | 175-0825-00 | | FT | | | | | | WIRE,ELECTRICAL:2 WIRE RIBBON | 08261 | OBD |
| -84 | 175-0826-00 | | FT | | | | | | WIRE,ELECTRICAL:3 WIRE RIBBON | 80009 | 175-0826-00 |
| -85 | 175-0827-00 | | FT | | | | | | WIRE,ELECTRICAL:4 WIRE RIBBON | 80009 | 175-0827-00 |
| -86 | 175-0829-00 | | FT | | | | | | WIRE,ELECTRICAL:6 WIRE RIBBON | 08261 | OBD |
| -87 | 175-0830-00 | | FT | | | | | | WIRE,ELECTRICAL:7 WIRE RIBBON | 08261 | OBD |
| -88 | 175-0831-00 | | FT | | | | | | WIRE,ELECTRICAL:8 WIRE RIBBON | 08261 | OBD |
| -89 | 352-0171-00 | | 1 | | | | | | CONN BODY,PL,EL:1 WIRE BLACK | 80009 | 352-0171-00 |
| -90 | 131-0707-00 | | 51 | | | | | | CONTACT,ELEC:0.48" L,22-26 AWG WIRE | 22526 | 5999-00-396-6331 |
| -91 | 352-0161-00 | | 1 | | | | | | CONN BODY,PL,EL:3 WIRE BLACK | 80009 | 352-0161-00 |
| -92 | 352-0162-00 | | 2 | | | | | | CONN BODY,PL,EL:4 WIRE BLACK | 80009 | 352-0162-00 |
| -93 | 352-0165-00 | | 3 | | | | | | CONN BODY,PL,EL:7 WIRE BLACK | 80009 | 352-0165-00 |
| -94 | 352-0167-00 | | 2 | | | | | | CONN BODY,PL,EL:9 WIRE BLACK | 80009 | 352-0167-00 |



SW 503 RF SWEEP GENERATOR



| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Dscont | Qty | 1 | 2 | 3 | 4 | 5 | Name & Description | Mfr Code | Mfr Part Number |
|----------------------|--------------------|----------------------|--------|-----|---|---|---|---|---|-----------------------------------|----------|-----------------|
| -1 | 118-0065-00 | | | 1 | | | | | | TERMINATION,GEN:50 OHM | 80009 | 118-0065-00 |
| -2 | 175-1178-00 | | | 1 | | | | | | CABLE,SP,ELEC:RF,20 INCH LONG | 80009 | 175-1178-00 |
| | 070-2051-00 | | | 1 | | | | | | MANUAL,TECH:INSTRUCTION | 80009 | 070-2051-00 |
| OPTIONAL ACCESSORIES | | | | | | | | | | | | |
| | 118-0070-00 | | | 1 | | | | | | DETECTOR,RF:50 OHM | 80009 | 118-0070-00 |
| | 118-0071-00 | | | 1 | | | | | | DETECTOR,RF:75 OHM(OPTION 1 ONLY) | 80009 | 118-0071-00 |

SW 503 RF SWEEP GENERATOR

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.

SERVICE NOTE

Because of the universal parts procurement problem, some electrical parts in your instrument may be different from those described in the Replaceable Electrical Parts List. The parts used will in no way alter or compromise the performance or reliability of this instrument. They are installed when necessary to ensure prompt delivery to the customer. Order replacement parts from the Replaceable Electrical Parts List.

CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

This chart compares TM 500 product performance to that of older Tektronix equipment. Only those characteristics where significant specification differences occur, are listed. In some cases the new instrument may not be a total functional replacement. Additional support instrumentation may be needed or a change in calibration procedure may be necessary.

Comparison of Main Characteristics

| | | |
|---|---|---|
| DM 501 replaces 7D13 | | |
| PG 501 replaces 107 | PG 501 - Risetime less than 3.5 ns into 50 Ω . | 107 - Risetime less than 3.0 ns into 50 Ω . |
| 108 | PG 501 - 5 V output pulse; 3.5 ns Risetime. | 108 - 10 V output pulse; 1 ns Risetime. |
| 111 | PG 501 - Risetime less than 3.5 ns; 8 ns Pretrigger pulse delay. | 111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger Pulse delay. |
| 114 | PG 501 - ± 5 V output. | 114 - ± 10 V output. Short proof output. |
| 115 | PG 501 - Does not have Paired, Burst, Gated, or Delayed pulse mode; ± 5 V dc Offset. Has ± 5 V output. | 115 - Paired, Burst, Gated, and Delayed pulse mode; ± 10 V output. Short-proof output. |
| PG 502 replaces 107 | | |
| 108 | PG 502 - 5 V output | 108 - 10 V output. |
| 111 | PG 502 - Risetime less than 1 ns; 10 ns Pretrigger pulse delay. | 111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger pulse delay. |
| 114 | PG 502 - ± 5 V output | 114 - ± 10 V output. Short proof output. |
| 115 | PG 502 - Does not have Paired, Burst, Gated, Delayed & Undelayed pulse mode; Has ± 5 V output. | 115 - Paired, Burst, Gated, Delayed & Undelayed pulse mode; ± 10 V output. Short-proof output. |
| 2101 | PG 502 - Does not have Paired or Delayed pulse. Has ± 5 V output. | 2101 - Paired and Delayed pulse; 10 V output. |
| PG 506 replaces 106 | PG 506 - Positive-going trigger output signal at least 1 V; High Amplitude output, 60 V. | 106 - Positive and Negative-going trigger output signal, 50 ns and 1 V; High Amplitude output, 100 V. |
| 067-0502-01 | PG 506 - Does not have chopped feature. | 0502-01 - Comparator output can be alternately chopped to a reference voltage. |
| SG 503 replaces 190, 190A, 190B, 191, 067-0532-01 | SG 503 - Amplitude range 5 mV to 5.5 V p-p. SG 503 - Frequency range 250 kHz to 250 MHz. SG 503 - Frequency range 250 kHz to 250 MHz. | 190B - Amplitude range 40 mV to 10 V p-p. 191 - Frequency range 350 kHz to 100 MHz. 0532-01 - Frequency range 65 MHz to 500 MHz. |
| TG 501 replaces 180, 180A | TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time. | 180A - Marker outputs, 5 sec to 1 μ s. Sinewave available at 20, 10, and 2 ns. Trigger pulses 1, 10, 100 Hz; 1, 10, and 100 kHz. Multiple time-marks can be generated simultaneously. |
| 181 | TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. | 181 - Marker outputs, 1, 10, 100, 1000, and 10,000 μ s, plus 10 ns sinewave. |
| 184 | TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time. | 184 - Marker outputs, 5 sec to 2 ns. Sinewave available at 50, 20, 10, 5, and 2 ns. Separate trigger pulses of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μ s. Marker amplifier provides positive or negative time marks of 25 V min. Marker intervals of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 μ s. |
| 2901 | TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time. | 2901 - Marker outputs, 5 sec to 0.1 μ s. Sinewave available to 50, 10, and 5 ns. Separate trigger pulses, from 5 sec to 0.1 μ s. Multiple time-marks can be generated simultaneously. |

NOTE: All TM 500 generator outputs are short-proof. All TM 500 plug-in instruments require TM 500-Series Power Module.

MANUAL CHANGE INFORMATION



PRODUCT SW503
070-2051-00

CHANGE REFERENCE M31733
DATE 5-17-77

CHANGE:

DESCRIPTION

EFF SN B010368

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

CR374 152-0008-00 SEMICOND DEVICE:SILICON,60V,60MA,T12G

R374 315-0471-00 RES.,FXD,CMPSN:470 OHM,5%,0.25W

The above parts are located on the SWEEP TIME GENERATOR circuit board and are shown on diagram 2 SWEEP TIME GENERATOR, POWER SUPPLY & COUNTER INTERFACE.



MANUAL CHANGE INFORMATION

PRODUCT SW503
070-2051-00

CHANGE REFERENCE M31789
DATE 6-2-77

| CHANGE: | DESCRIPTION |
|---------|-------------|
|---------|-------------|

EFF SN B020460

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

R230 315-0472-03 RES., FXD, CMPSN:4.7K OHM, 5%, 0.25W

R234 315-0103-00 RES., FXD, CMPSN:10K OHM, 5%, 0.25W

R230 and R234 are located on the MOTHER board and are shown on diagram 3 SWEEP & MARKER AMPLIFIERS.