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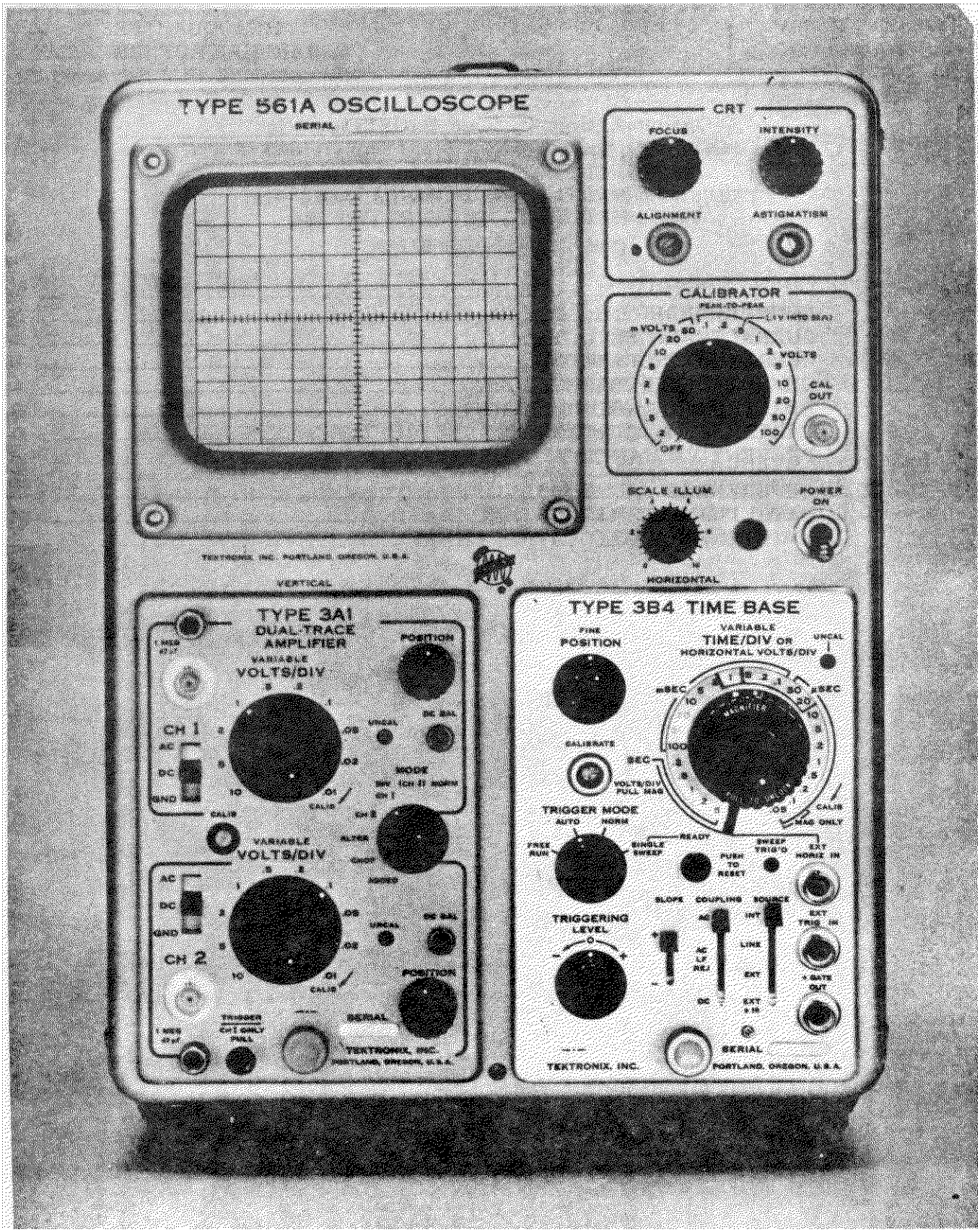
Operator's, Organizational, Direct Support, and
GENERAL SUPPORT MAINTENANCE MANUAL,
INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST:
TIME BASE PLUG-IN, TEKTRONIX TYPE 3B4
(NSN 4931-00-910-8226)

Page


TYPE 561A OSCILLOSCOPE
SERIAL
CRT
FOCUS
INTENSITY
ALIGNMENT
ASTIGMATISM
CALIBRATOR
PEAK-TO-PEAK
VOLTS
CAL OUT
OFF
SCALE ILLUM
POWER ON
HORIZONTAL
VERTICAL
TYPE 3A1
DUAL-TRACE
AMPLIFIER
VARIABLE
VOLTS/DIV
POSITION
CH 1
CH 2
MODE
TRIGGER
SERIAL
TEKTRONIX, INC.
PORTLAND, OREGON, U.S.A.
TYPE 3B4 TIME BASE
FINE
POSITION
VARIABLE
TIME/DIV OR
HORIZONTAL VOLTS/DIV
CALIBRATE
TRIGGER MODE
AUTO
NORM
FREE RUN
SINGLE SWEEP
READY
PUSH TO RESET
SWEEP TRIG'D
EXT HORIZ IN
TRIGGERING LEVEL
SLOPE
COUPLING
SOURCE
AC
AC LF REJ
DC
INT
LINE
EXT
EXT ÷ 10
EXT TRIG IN
+ GATE OUT
SERIAL
TEKTRONIX, INC.
PORTLAND, OREGON, U.S.A.

SECTION 0

INTRODUCTION

SCOPE

This manual includes installation and operation instructions and covers organizational, direct support (DS), and general support (GS) maintenance. It describes Time Base Plug-In, Tektronix Type 3B4.

The basic issue items list appears in Appendix B. Appendix B is current as of 24 November 1971.

INDEXES OF PUBLICATIONS

DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine if there are any new editions, changes, or additional publications pertaining to the equipment.

DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are Modification Work Orders (MWO's) pertaining to the equipment.

FORMS AND RECORDS

Reports of Maintenance and Unsatisfactory Equipment. Use equipment forms and records in accordance with instructions given in TM 38-750.

Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 as prescribed in AR 700-58 (Army), NAVSUP Pub 378 (Navy), AFR 71-4 (Air Force), and MCO P4030.29 (Marine Corps).

Discrepancy in Shipment Report. Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38 (Army), NAVSUP Pub 459 (Navy), AFM 75-34 (Air Force), and MCO P4610.19 (Marine Corps).

Reporting of Errors. The reporting of errors, omissions, and recommendations for improving this manual is encouraged. Reports should be submitted on DA Form 2028, Recommended Changes to Publications, and forward direct to: Commander, U.S. Army TMDE Support Group, ATTN: AMXTM-LML, Redstone Arsenal, AL 35898-5400.

SECTION 1

CHARACTERISTICS

Introduction

The Type 3B4 Time Base plug-in unit is designed to be used primarily with the Tektronix Type 561A Oscilloscope system; however, it can also be used with the other 560-Series systems that use 3B-Series plug-in units such as the Type 564 and Type 567. As part of an oscilloscope system, the Type 3B4 is used as an accurate time base generator or as a calibrated amplifier for externally generated deflection signals.

When used with the 567 or RM567, the 3B4 provides a time-base, but does not activate the digital readout circuitry. In the 565 or RM565, the 3B4 provides a vertical time-base for raster applications but does not provide retrace blanking.

The Type 3B4 provides calibrated sweep rates from 0.05 msec/div to 5 sec/div in 25 calibrated steps. A five-step, direct-reading magnification feature provides magnification up to 40X or 50X, depending on the sweep rate to which magnification is applied. When the Type 3B4 is used as an amplifier for externally generated deflection signals, the magnifier provides five steps of deflection sensitivity, from 0.2 volts/div to 5 volts/div. In addition, a variable control provides uncalibrated sweep rates and deflection sensitivities between the calibrated steps. By using the variable control, uncalibrated sweep rates from 0.05 msec/div to approximately 12.5 sec/div and deflection sensitivities from 0.2 volts/div to approximately 12.5 volts/div are available. Uncalibrated operation is indicated by a neon lamp.

Normally, the Type 3B4 is inserted in the right-hand compartment (operator's right, oscilloscope's left) of the oscilloscope and in this position provides horizontal deflection. When used with the Type 561A, the Type 3B4 can be inserted into the left-hand compartment of the oscilloscope to provide a time base that runs vertically on the crt screen. Due to differences in the horizontal and vertical deflection plate sensitivities, the Type 3B4 must be calibrated for vertical deflection use if accuracy is required in such application. This manual is written with the assumption that the Type 3B4 will normally be used to provide horizontal deflection signals in a Type 561A.

Triggering

Facilities

TRIGGER MODE Switch	Free Run, Auto, Normal, and Single Sweep
TRIGGERING LEVEL Control	See Tables 1-1 and 1-2.
SLOPE Switch	+ or -
COUPLING Switch	Ac, Ac Low-Frequency Reject, and Dc
SOURCE Switch	Internal, Line, External, and External ÷ 10

TRIGGERING LEVEL Control Voltage Range (external triggering)

See Table 1-1.

TABLE 1-1

SOURCE	COUPLING	Voltage Range	
		Typical	Minimum
EXT	AC, DC or AC LF REJ	±19v	±15v
EXT ÷ 10	AC or DC	±190v	
	AC LF REJ		±150v

NOTE

The voltage range of the TRIGGERING LEVEL control indicates the maximum external peak voltage that will permit triggering at any amplitude point on the signal. Signals with greater amplitudes can be used and will provide triggering, but the range of trigger-point selection is still limited to the TRIGGERING LEVEL control voltage range.

Triggering Sensitivity. See Table 1-2.

TABLE 1-2

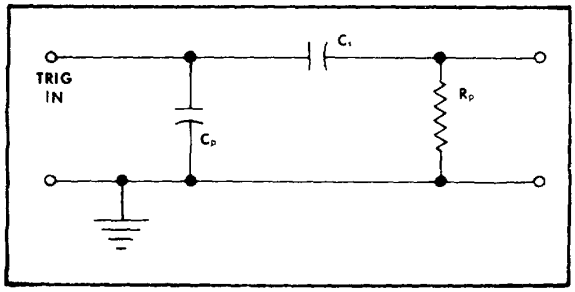
SOURCE	Voltage Range		
	AC	AC LF REJ	DC
INT	1 minor division of deflection 30 cps to 20 mc. Outside these limits requires larger triggering signal.	1 minor division of deflection 30 kc to 20 mc. Outside these limits requires larger triggering signal.	1 minor division of deflection dc to 20 mc (with trace vertically centered). Above 20 mc requires larger triggering signal.
EXT	0.2 v 30 cps to 20 mc. Outside these limits requires larger triggering signal.	0.2 v 30 kc to 20 mc. Outside these limits requires larger triggering signal.	0.2 v dc to 20 mc (with trace vertically centered). Above 20 mc requires larger triggering signal.

Automatic Triggering. In this mode of operation a bright-line sweep is displayed automatically in the absence of a trigger. The sweep triggering characteristics stated previously also apply for automatic triggering except that the triggering signal must be higher than about 20 cps. The TRIGGERING LEVEL control operates when a triggering signal is present.

Single Sweep. This feature permits only one triggered sweep following each reset pulse. The reset pulse is generated by pressing the PUSH TO RESET button. The triggering characteristics stated previously apply.

EXT TRIG IN Connector Input Characteristics. See Table 1-3.

TABLE 1-3



SOURCE	COUPLING	C_p (pf)	C_s	R_p (Meg Ω) Max	Input Voltage Peak
EXT	DC	≈20	shorted	≈1	±75
	AC	≈20	≈0.01 μf	≈1	±500
	AC LF REJ	≈20	≈100 pf	≈0.09	±500
EXT ÷ 10	DC	≈5	shorted	≈10	±500
	AC	≈5	≈0.01 μf	≈10	±500
	AC LF REJ	≈20	≈100 pf	≈1	±500

Sweep

Facilities

TIME/DIV Switch	0.2 *m*sec/div to 5 sec/div in 23 steps, 1, 2, 5 sequence. The calibration accuracy (unmagnified) is ±3% from 0.2 *m*sec/div to 2 sec/div; ±5% at 5 sec/div.
VARIABLE Control	Uncalibrated variable time/div control. Multiplies the sweep time/div of any step of the TIME/DIV switch by a factor variable from 1 to ≥2.5.
POSITION Controls	Coarse horizontal positioning to position any portion of the trace to the center of the crt. The FINE control has a range of about 2 minor divisions.
MAGNIFIER Control	Provides direct readout magnification of the sweep (up to 50X). The magnifier also provides the 0.05 and 0.1 *m*sec/div sweep rates. Magnified sweep accuracy, ±5% (exception: 5 sec/div). Magnified sweep registration, ±1 minor division.
+ GATE OUT Connector	Provides a +20-volt (±10%) output pulse during sweep time.
Sweep Length	10.5 ±0.3 major division.

Sweep Amplifier (when used as an external horizontal amplifier)

Facilities

HORIZONTAL VOLTS/DIV Switch	Calibrated volts/div steps of 0.2, 0.5, 1, 2, and 5 volts/div. Accuracy ±3% when calibrated to match the oscilloscope in which used. The amplifier is dc coupled to the EXT HORIZ IN connector.
VARIABLE Control	Multiplies volts/div of any step by a factor variable from 1 to ≥2.5.
EXT HORIZ IN Connector	Input R and C is typically 1 megΩ shunted by 40 pf.
Frequency Response	Dc to 400 kc. Response ≤30% down at 400 kc with the VARIABLE control set to CALIB position.
Maximum Input Voltage	±20 volts dc, or 20 volts peak ac.

Environmental

Operating

TEMPERATURE	0°C to +50°C.
ALTITUDE	10,000 feet maximum.
VIBRATION	0.015 inch peak-to-peak, (1.9 G,s) for 15 minutes along each axis. Vibration frequency varied from 10-50-10 cps in 1-minute cycles.

Non Operating

TEMPERATURE	-35°C to +60°C.
ALTITUDE	50,000 feet maximum.
VIBRATION	0.015 ±0.003 inch total displacement from 10 to 5 cycles.
TRANSIT	Meets National Safe Transit type of test when factory packaged: Vibration for one hour at slightly greater than 1G. 30-inch drops on corners, edges and flat surfaces.

Mechanical

Construction	Aluminum-alloy chassis with chrome-plated side rails. Front panel is photo-etched and anodized.
Dimension (approx.)	6 1/4 inches high, 4 1/4 inches wide, 14 1/2 inches deep (overall).
Net Weight	4.5 pounds.

Accessories

Information on accessories for use with this instrument is included at the rear of the mechanical parts list.

SECTION 2

OPERATING INSTRUCTIONS

Front-Panel Controls and Connectors

See Fig. 2-1.

NOTE

A more complete description of the controls and connectors is included under "Standard Sweep Operation" later in this section.

TRIGGER MODE Switch	Selects the manner in which the Time Base sweeps are initiated. For example:
FREE RUN	In this position, recurrent sweeps are provided. The completion of one sweep causes the next to begin.
AUTO	Automatic sweep. Permits each sweep to be triggered when the triggering-signal repetition rate is about 20 cps or greater. For lower repetition rates or in the absence of a triggering signal, the sweeps are recurrent, as in the FREE RUN position.
NORM	Normal method of operation. Each sweep is triggered by the signal from the internal trigger generator.
SINGLE SWEEP and PUSH TO RESET	Often used when displays of non-repetitive signals are photographed. When the lamp inside the PUSH TO RESET button is lit, the time base is ready to produce one triggered sweep.
SOURCE	Selects the source of the triggering signal:
INT	Internal. Obtains the sweep triggering signal from the vertical plug-in unit.
LINE	Obtains the sweep triggering signal from a low-voltage winding on the oscilloscope power transformer.
EXT and EXT ÷ 10	Permits external signals applied to the EXT TRIG IN connector to be used for sweep triggering. High-amplitude triggering signals can be attenuated by using the EXT ÷ 10 position.
COUPLING	Permits acceptance or rejection of some triggering signal characteristics:
AC	Rejects dc and attenuates very low-frequency ac triggering signals.
AC LF REJ	Ac low-frequency reject. Rejects dc and discriminates against low-frequency ac triggering signals. The 30% down point is 17 kc.
DC	Accept ac and dc triggering signals.
SLOPE (+ or -)	Determines whether triggering will occur during the positive-going (+) or negative-going (-) portion of the triggering signal.
TRIGGERING LEVEL	Selects the amplitude point on the triggering signal where triggering will occur.
TIME/DIV OR HORIZONTAL VOLTS/DIV	Provides 23 calibrated display sweep rates (unmagnified). See Fig. 2-1. The number opposite the dot on the MAGNIFIER knob skirt always indicates the sweep time per centimeter as long as the VARIABLE control is in the CALIB position. The number bracketed by the two heavy black lines on the clear plastic knob flange is the **unmagnified** sweep time per division. To change the **unmagnified** sweep rate, the concentric flange and the MAGNIFIER knob must first be interlocked by positioning the dot on the MAGNIFIER knob between the two heavy black lines on the flange. When the flange is positioned so that the two black lines bracket the EXT HORIZ IN position, any signal connected to the EXT HORIZ IN connector is applied to the horizontal amplifier. In this position of the switch, the amplified externally generated signal provides horizontal deflection.
MAGNIFIER	Provides magnification of the time base display up to 40X or 50X in five direct-reading steps (Magnification of the four fastest **unmagnified** sweep rates is limited to 0.05 μsec/div). For example, at 10X magnification, the 5 minor division segment at the center of an unmagnified crt display is horizontally expanded to full graticule width. Any other 5 minor division segment of the original unmagnified display may then be observed in magnified form by turning the POSITION controls. To determine the degree of magnification, divide the number bracketed by the two black lines on the clear plastic flange by the number adjacent to the dot on the MAGNIFIER knob.
VARIABLE	Provides continuously variable uncalibrated sweep rates between about 0.4 and 1.0 times that indicated by the TIME/DIV switch. Whenever the VARIABLE knob is not set to CALIB, the UNCAL lamp lights. When the TIME/DIV switch is set to the EXT HORIZ IN position, the VARIABLE knob provides ≈ 2.5:1 change in horizontal amplifier sensitivity.

STANDARD SWEEP OPERATION

The control and switch settings listed under “First-Time Operation” later in this section establish the basic conditions necessary for most measurements. In many applications, it is desirable for a repetitive signal to produce a stationary

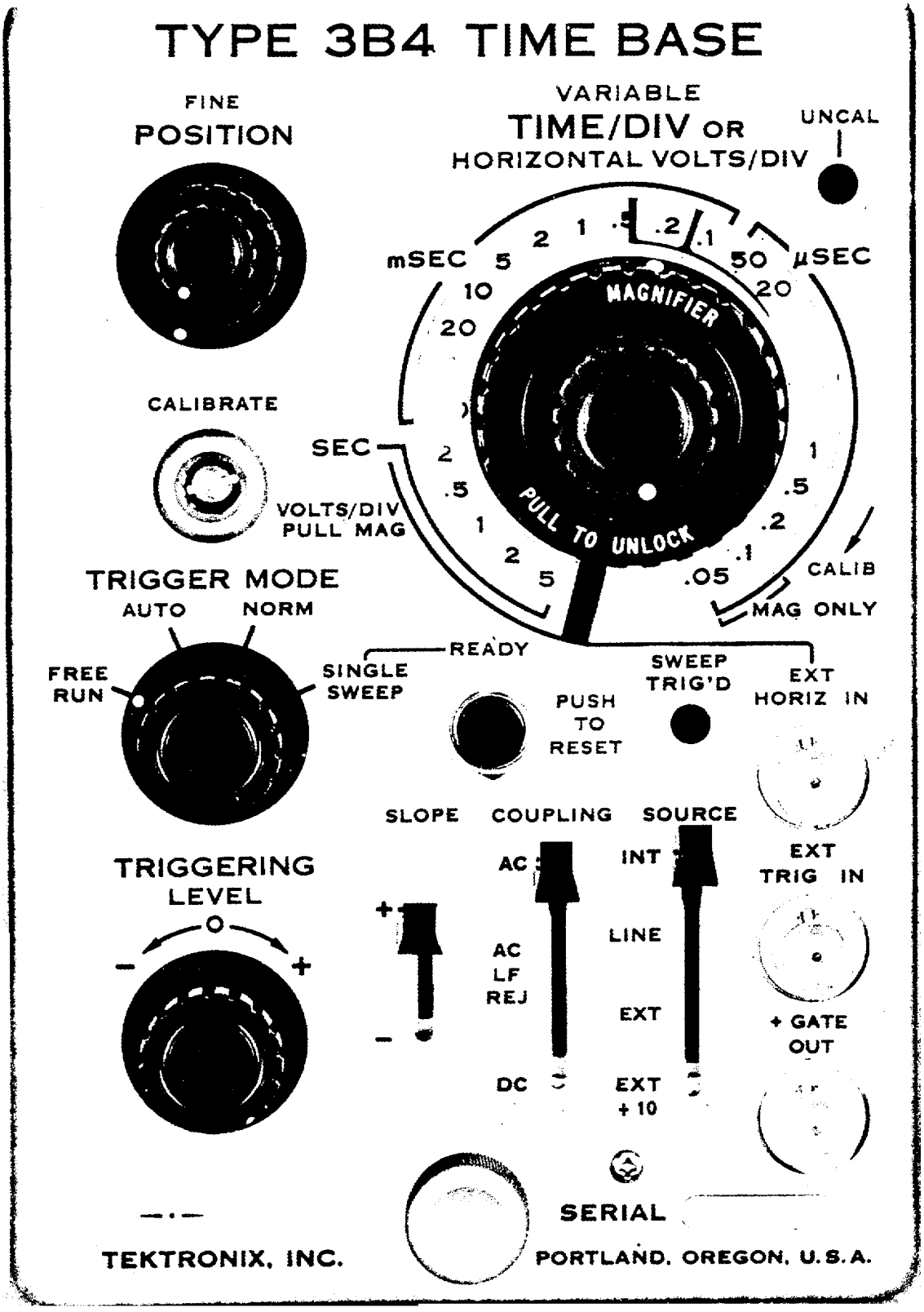


Fig 2-1. Front Panel Controls and Connectors.

display on the crt so the waveform can be examined in detail. For this type of display, the start of each sweep must bear a definite fixed-time relationship to the events in the input signal. This can be accomplished by using the displayed signal or another related signal to start (trigger) single or repetitive sweeps. The following is a detailed description of the control and switch settings which provide complete control over the means of triggering the sweep. It is assumed that the oscilloscopes system is a Tektronix Type 561A.

TRIGGER MODE

FREE RUN. Free-running operation produces continuously repetitive sweeps even in the absence of a triggering signal. These sweeps provide a reference trace, as does the AUTO position. This method of operation is useful in applications where a device under test requires a trigger or input signal. The front-panel +GATE OUT signal may be used to operate the device under test. The resulting signal displayed on the crt will then be synchronized with the sweep.

AUTO. This position is frequently used for ease of operation and because of the reference trace produced in the absence of a triggering signal. The time base free runs without the application of a trigger. If a triggering signal is received, the free running is interrupted, but this first event in the signal does not trigger a sweep. If the first signal event is followed by a second event within about 80 msec, a triggered sweep is initiated, and if not, the free running resumes. Since the dormant period is limited to about 80 msec, signal frequencies below about 20 cps cannot produce a triggered sweep in the AUTO mode. For such signals, the NORM mode of operation is used.

With the SOURCE switch set to INT and the TRIGGER MODE switch set to AUTO, the sweep will trigger on any signal that will trigger the NORM mode (about 1 minor division of deflection) so long as the triggering signal is above about 20 cps. When operating in the AUTO mode, it is necessary to adjust the TRIGGERING LEVEL control to lock the sweep with the triggering signal.

NORM. In the NORM or normal mode, the time base is dormant in the absence of a triggering signal. Each sweep must be initiated by a triggering signal.

SINGLE SWEEP. Single sweep is often used when photographing non-repetitive waveforms and in other applications where the vertical input signal continually varies in amplitude shape, or time interval. A continuous display of such signals would appear as a jumbled mixture of many different waveforms and would yield little or no useful information. The Type 3B4 permits a single sweep to be presented with the elimination of all subsequent sweeps. The information in the one sweep is thus clearly recorded without the confusion resulting from multiple nonrepetitive traces.

When the TRIGGER MODE switch is set to SINGLE SWEEP, the time base becomes inoperative. The time base can be "reset" to the triggerable condition by pressing the RESET button. If there is sufficient delay before triggering, the RESET lamp will light to show that the time base is ready to be triggered. When the time base has been triggered and one sweep completed, the time base again becomes inoperative and the lamp extinguishes.

SOURCE

INT. It is usually easiest to obtain the sweep triggering signal internally (INT) from the vertical deflection system.

LINE. If the displayed signal frequency is related to the power-line frequency, the line source can be used. This source is useful when the displayed signal does not allow internal triggering.

EXT. External triggering is often used when signal tracing in amplifiers, phase-shift networks, and wave-shaping circuits. The signal from a single point in the circuit can be connected to the EXT TRIG IN connector through a signal probe or a cable. With this signal triggering the sweep, it is possible to observe the shaping, amplification, and time relationship of a signal at various points in the circuit without resetting the triggering controls.

EXT. ÷ 10. The only difference between external (EXT) and external divided-by-10 (EXT ÷ 10) is that the latter attenuates the external triggering signal. Attenuation of high-amplitude external triggering signals is desirable to broaden the TRIGGERING LEVEL control range.

DC. Dc coupling allows the trigger circuits to receive signals of all frequencies from dc upward. It is best to dc couple for very low-frequency signals (below about 20 cps).

AC. Ac coupling rejects the dc component of triggering signals and increasingly attenuates ac triggering signals as the frequency decreases. This position of the coupling switch is not normally used for triggering signals below about 20 cps, but this is the most used position of the switch.

AC LF REJ. Ac low-frequency reject coupling rejects the dc component of triggering signals and increasingly attenuates ac signals as frequency decreases (30% down point 17 kc). If line-frequency hum is mixed with a desired high-frequency triggering signal, best results are obtained by using this position of the COUPLING switch.

Ac low-frequency reject coupling should also be used when triggering internally from multi-trace plug-in units operated in the alternate-trace mode (unless the "trigger from a single channel only" feature of the plug-in is used). For additional information, see the multi-trace vertical plug-in unit instruction manual.

SLOPE

Sweeps can be triggered during either the rising or falling portion of the triggering signal. When the display consists of several cycles of the input signal, either setting of the SLOPE switch may be used. However, if it is desired to display less than one full cycle of the input signal, the SLOPE switch permits the sweep to start on either the rising (+ slope) or falling (- slope).

TRIGGERING LEVEL

The TRIGGERING LEVEL control determines the instantaneous voltage on the triggering signal at which the sweep is triggered. (This instantaneous voltage can also include a dc level if the COUPLING switch is set to DC.)

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With the SLOPE switch at +, adjusting the TRIGGERING LEVEL control makes it possible to trigger the sweep consistently at virtually any point on the positive slope of the triggering signal. Likewise, with the SLOPE switch at -, adjusting the TRIGGERING LEVEL control makes it possible to trigger at virtually any point on the negative slope of the triggering signal.

TIME/DIV OR HORIZONTAL VOLTS/DIV

The Time Base has 23 calibrated sweep rates ranging from 0.2 *m*sec/div to 5 sec/div (unmagnified). See Fig. 2-2. The number opposite the dot on the MAGNIFIER knob indicates the sweep time per division as long as the VARIABLE control is in the CALIB position. The **unmagnified** sweep rate value being used appears between the two black lines on the clear plastic flange of the TIME/DIV control. The VARIABLE control and MAGNIFIER switch, used in conjunction with the TIME/DIV switch, permit the sweep rate to be varied continuously between 50 nsec/div and about 12.5 sec/div. The MAGNIFIER switch is discussed under "MAGNIFIER". All sweep rates obtained with the VARIABLE control in any but the fully clockwise position are uncalibrated. Uncalibrated sweep rates are indicated when the UNCAL lamp is lit.

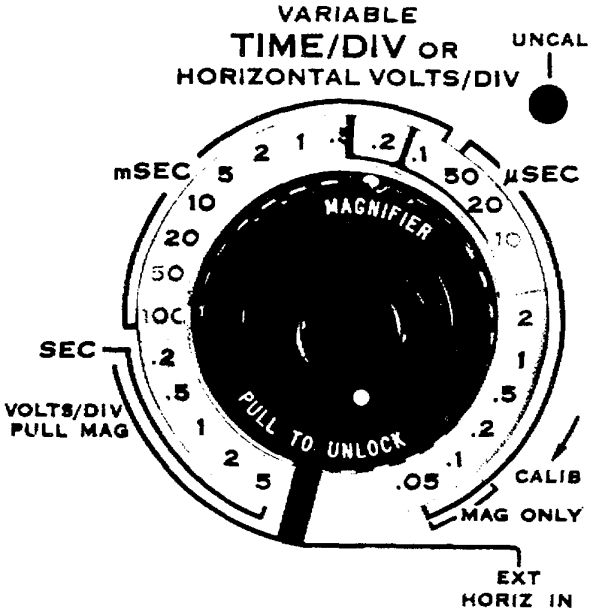

Fig. 2-2. TIME/DIV OR HORIZONTAL VOLTS/DIV and MAGNIFIER KNOBS.

When the flange is positioned so that the two heavy black lines bracket the EXT HORIZ IN position the horizontal amplifier input is connected to the EXT HORIZ IN connector and accepts external horizontal deflection signals. In this mode of operation, five ranges of horizontal deflection sensitivity are available. The five sensitivity ranges are from 0.2 volts/div to 5 volts/div.

To position the TIME/DIV switch to the EXT HORIZ IN position, turn the MAGNIFIER knob until the dot on the knob is positioned between the two block lines on the clear plastic flange. Turn the knob until the two black lines on the flange bracket the position marked "EXT HORIZ IN". The external horizontal deflection sensitivity may now be selected by pulling the MAGNIFIER knob outward to unlock it, then, while holding the knob out, turn it to the desired volt/div position.

MAGNIFIER

The sweep ranges between 5 sec/div and 2 *m*sec/div can be magnified up to 40X or 50X in 5 steps. The degree of magnification is the ratio between the indicated magnified rate (number opposite the dot on the skirt of the MAGNIFIED knob) and the indicated unmagnified rate (number bracketed by two black lines on the clear plastic flange). Since the magnified display rate is always direct reading, it is seldom necessary to determine the actual magnifying factor used.

Above 2 *m*sec/div the number of steps of magnification decrease until at the .2 *m*SEC setting of the TIME/DIV switch only two steps of magnification are available. The .2 *m*SEC position is the highest sweep rate to which the TIME/DIV switch can be set, but by the use of the two additional magnified positions, and effective sweep rate of 50 nSEC/DIV is obtained.

FIRST-TIME OPERATION

The following control and switch settings for the Type 3B4 can be used for a wide range of measurements. The operating conditions established by these settings also provide a starting point for the operator who is learning to use the instrument.

TRIGGER MODE	AUTO
COUPLING	AC
SOURCE	INT
VARIABLE (TIME/DIV)	CALIB fully clockwise)
MAGNIFIER	Locked to TIME/DIV switch

The Type 3B4 now provides the time base for measurements of vertical deflection signals above about 20 cps. In many cases, only the TIME/DIV switch and the TRIGGERING LEVEL control require readjustment when progressing from one measurement to the next.

The appropriate TIME/DIV switch setting depends on the frequency of the applied signal and the type of measurement. For example, to observe about 2 cycles of the oscilloscope 60 cycle Calibrator signal, set the TIME/DIV switch to 5 mSEC.

The following conditions must exist to obtain a triggered display of the vertical deflection signal with the preceding control settings:

1. The frequency of the vertical deflection signal must be about 20 cps or greater (below 20 cps, the TRIGGER MODE switch must be set to NORM).
2. At 50 kc the vertical deflection amplitude must be at least 1 minor division. See Table 1-2.

3. The TRIGGERING LEVEL control must be properly adjusted.

If the first two conditions are met, a stable display will be obtained with the TRIGGERING LEVEL control set near zero. When the observed deflection amplitude is a fraction of a division, the range of adjustment is relatively narrow but broadens with increased vertical deflection.

Operating Techniques

The following procedures are designed to acquaint the operator with the function of the various controls on the Type 3B4.

Example 1, Time Measurement: This example explains how to measure the time of one-half cycle of the calibrator square-wave output. Set the Type 3B4 controls as outlined in Table 2-1.

TABLE 2-1

Typical Control Settings for Time Measurements

Control	Settings
TRIGGER MODE	AUTO
TIME/DIV	1 mSEC
MAGNIFIER	1 mSEC
SLOPE	(—)
COUPLING	AC
SOURCE	INT
VARIABLE	CALIB

With the controls set as outlined in Table 2-1, apply a 2-volt signal from the calibrator to the input of the vertical plug-in amplifier. Set the VOLTS/DIV switch on the vertical plug-in for 4 divisions of vertical deflection. Turn the vertical plug-in POSITION control until the vertical deflection extends 2 divisions above and 2 divisions below the horizontally scribed centerline. Turn the POSITION and FINE control until the 50% point on the positive half-cycle of the square wave starts 1 division from the left edge of the graticule. With the equipment properly calibrated, the 50% point on the trailing edge of the half-cycle occurs 8.33 divisions to the right of the 50% point of the leading edge. Since the TIME/DIV switch is set to 1 mSEC, the positive half-cycle of the square wave is 8.33 msec long.

Example 2, Risetime Check: At the completion of the measurement listed in Example 1, unlock the MAGNIFIER knob by pulling it out, then, while holding it out, set it to the 20 *m*SEC position. Using the POSITION control, position the leading edge of the positive half-cycle at the vertically-scribed centerline. Using the POSITION and FINE controls, carefully reposition the leading edge until the 10% point on the pulse crosses the horizontally-scribed centerline 2 minor graticule divisions up from the start of the pulse. After the leading edge of the pulse is properly positioned, note the position of the 90% point of the rise. Since there is no easy point of reference from which to read, use the POSITION control of the vertical plug-in amplifier to move the 90% point down to the horizontally-scribed centerline. The 90% point will intersect the horizontally-scribed centerline less than one major graticule division to the right of the vertically-scribed centerline, thus providing a 10% to 90% risetime of less than 20 *m*sec.

Example 3, Type 3B4 Used as a Trigger Source: Ordinarily, the signal to be displayed is also used to trigger the oscilloscope. In some instances, it may be desirable to reverse this situation. The sweep-related output pluses, available at the front panel of the Type 3B4 can be used as the input or triggering signal for external devices. The output signal of the external device will then produce a stable display while the oscilloscope free runs. For this type of operation, set the controls on the Type 3B4 as listed in Table 2-1 except set the TRIGGER MODE switch to FREE RUN. Connect the Type 3B4 +GATE OUT output to the external device to be triggered. Since the external device is now being triggered with a signal that has a fixed time relationship to the oscilloscope sweep, the output of the external device will produce a stable display on the oscilloscope, as though the oscilloscope were triggered in the normal manner.

Example 4, External Horizontal Deflection: For special applications, it is possible to produce horizontal deflection with an externally derived signal. This permits the oscilloscope system to be used to plot one function against another (e.g., Lissajous figures). However, the system is not intended for precise phase-angle measurements.

To use an external signal for horizontal deflection, connect the signal to the EXT HORIZ IN connector. Set the TIME/DIV OR HORIZONTAL VOLTS/DIV switch to EXT HORIZ IN.

Sensitivity of the horizontal deflection system is changed by changing the MAGNIFIER switch when using external horizontal deflection. To change sensitivity, pull the MAGNIFIER knob out to unlock it, then set to the selected position of the SEC OR EXT VOLTS positions.

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SECTION 3

CIRCUIT DESCRIPTION

Introduction

This section contains the theory of operation of the various circuits in the Type 3B4. The discussions ore supported by the block diagram and schematics in Section 5. The relationship of the circuits in a particular block to those in other portions of the system is discussed in the description of that block

The block diagram in Section 5 shows the basic elements of the Type 3B4. The Trigger Generator blocks select and shape triggering signals and apply trigger pulses to the Sweep Generator blocks. The Sweep Generator generates a linear-ramp horizontal deflection voltage, and in addition, adapts externally generated signals to provide horizontal deflection when such operation is desired. From the Sweep Generator blocks, the horizontal deflection signals are applied to the Horizontal Amplifier, where they are split in phase and amplified sufficiently to provide the degree of magnification being used.

Trigger Generator

For best triggering stability, the Sweep Generator requires trigger pulses that are representative of the triggering frequency but with greater wave-shape consistency than the signals generally encountered. The Trigger Generator converts the triggering signal into a pulse having a consistently fast risetime while retaining the characteristic repetition frequency of the triggering signal. The converted pulse is then used to trigger the Sweep Generator, which generates the time base.

The signal to be used for triggering is selected by means of SOURCE switch SW5 (see Trigger Generator schematic) from one of three sources: the vertical plug-in (INT); a low-voltage winding on the oscilloscope power transformer (LINE); or from an external signal applied to EXT TRIG IN connector J1 (EXT).

COUPLING switch SW8 selects which of the three input coupling methods is to be used; ac, ac with low frequencies rejected, or dc. From the COUPLING switch, the signal is applied through SLOPE switch SW10 to one side of a long-toiled comparator circuit (V24 and associated circuit elements) used as a trigger recognizer.

In operation, V24A in the comparator is kept cut off by V24B until the selected point on the triggering signal occurs. With SLOPE switch SW10 in the + position, TRIGGERING LEVEL control R16A applies conducting bias to V24B. With V24B conducting, the current flow through R22 develops a voltage which keeps V24A cut off. When the triggering signal goes positive to the selected trigger point, V24A starts to conduct and cuts off V24B. If the SLOPE switch is set to -, TRIGGERING LEVEL control R16A is set to deliver cut-off bias to V24A while V24B is permitted to conduct due to its grid being grounded through R10 and R7. As the triggering signal goes negative, it reaches a point where it cuts off V24B. With V24B cut off, V24A is forced into conduction by virtue of the -100 volts applied to its cathode through R22.

During the time that V24A is cut off and the comparator is waiting for the proper triggering conditions to occur, current flow through R24 and R26 develops cutoff bias for Q24 since the emitter of Q24 is strapped to the +125 volt supply through diode D28. When the comparator is switched by the triggering signal and V24A starts to conduct, the conduction of V24A reverses the current flow through R24 and applies conducting bias to Q24. Also during the time the comparator is waiting to be switched, tunnel diode D30 is biased to its low voltage state (see Fig. 3-1) by the voltage developed across R32 and L32. When Q24 is biased into conduction by the switching of the comparator, the conduction of Q24 provides about 2.5 ma of current to D30 which causes D30 to switch to its high voltage state.

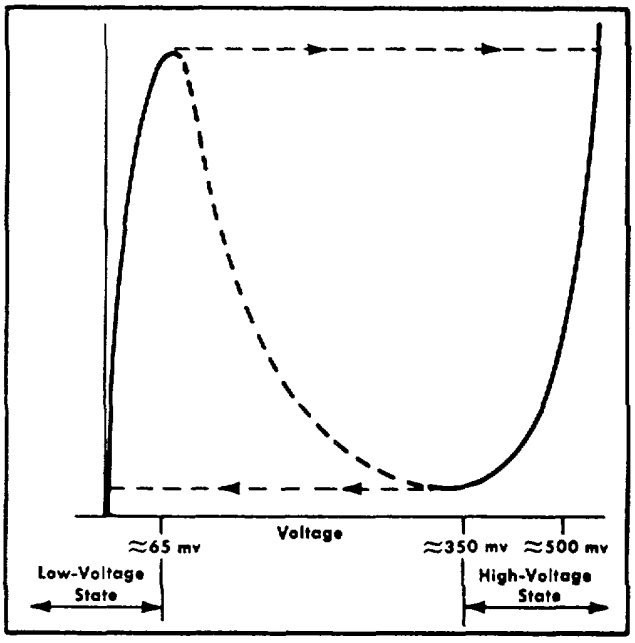

Fig. 3-1. Current-Voltage Characteristics of a Typical Tunnel Diode.

The switching of a tunnel diode from its low voltage state to its high voltage state is extremely fast. When D30 switches to its high voltage state due to the turning on of Q24, the jump in voltage across D30 appears on the base of Q34. Q34 is normally conducting, and the sudden increase in its base to emitter voltage causes a corresponding increase in current. The sudden demand for current by Q34 is met by drawing current from C33. Since the time constant of the circuit is short, the current increase through Q34 is in the nature of a sharp pulse. The pulse is coupled out through T38 of the Sweep Generator.

Sweep Generator

Outputs and Triggering. When the TIME/DIV OR HORIZONTAL VOLTS/DIV switch is set to any of the TIME/DIV positions, the Sweep Generator (see Block Diagram)

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produces four simultaneous output signals:

1. A positive-going sawtooth that is applied to the Horizontal Amplifier.

2. A negative-going crt unblanking pulse with the same time duration as the sweep sawtooth rise. This pulse is coupled to the oscilloscope crt.

3. A positive-going pulse with the same duration as the sweep. This pulse is coupled to the front-panel +GATE OUT connector for external use.

4. A negative-going multi-trace sync pulse. This pulse is applied to the vertical plug-in unit interconnecting socket. The pulse is used to switch channels in a multi-trace plug-in unit when operating in the alternate mode.

In most applications, each cycle of events is started by a trigger pulse from the Trigger Generator. However, it is also possible to free run the Sweep Generator; that is, the end of one cycle causes the next cycle to begin. The desired operation is selected by the TRIGGER MODE switch. The four operating modes provided by the TRIGGER MODE switch are described in Section 2 of this manual.

The Sweep Gating circuit is an electronic switch that drives the Disconnect circuit to switch the Disconnect Diodes on and off. When the Disconnect Diodes are switched off, the Miller Runup Integrator begins to produce a sawtooth that is fed back through the Lockout circuit to the Sweep Gating circuit. When the sawtooth reaches the desired amplitude, the Lockout circuit resets the Sweep Gating tunnel diode, the Disconnect Diodes are switched back on, and the Miller Runup resets to form the retrace or falling portion of the sawtooth. Following a short stabilization period, the Sweep Generator is ready to repeat the sequence.

Operating Modes. The TRIGGER MODE switch provides four ways to switch the Sweep Gating circuit so that the sweep begins:

1. In NORM, the Sweep Gating circuit is switched by a pulse from the Trigger Generator.

2. In SINGLE SWEEP, two pulses are required to start each sweep. First, a pulse from the Reset circuit (originating at the RESET pushbutton) resets the Lockout Multi. Then, after reset, the Sweep Goring circuit can be switched by a pulse from the Trigger Generator.

3. FREE RUN results in recurrent sweeps that are independent of any triggering signal. The switching of the Lockout Multi at the end of the holdoff period makes available enough current to switch the tunnel diode in the Sweep Gating circuit.

4. The AUTO position is a combination of NORM and FREE RUN. If there are no trigger pulses coming from the Trigger Generator, the Auto Trigger Multi permits the sweep gating circuit to "free run". When a pulse comes from the Trigger Generator, the Auto-Trigger Multi switches the Sweep Gating circuit to the '"normal" condition, but this first trigger pulse does not start a sweep. If the first trigger pulse is followed by a second within about 80 msec, the Sweep Gating circuit switches and a sweep begins. If trigger pulses continue to arrive every 80 msec or less, the Auto Trigger Multi remains in the "normal" condition and each sweep is a triggered sweep. Whenever the period between trigger pulse; exceeds 80 msec, the Auto Trigger Multi reverts to thc free-run condition until the next trigger pulse arrives.

Circuit operation in each of the modes is described in the following paragraphs While reading the discussion, reference should be made to the Sweep Generator schematic in Section 5.

NORM, Quiescent Conditions. In the quiescent state, that is, when the sweep generator is triggerable and is waiting for a trigger pulse, the circuit conditions are as follows:

Q125 in the Lockout Multi is conducting and holds Q135 cut off. With Q135 cut off, the current flow through R143, R144, and R145 is about 3.8 ma, which is enough to bias tunnel diode D143 close to the point where it will switch to its high voltage state. With D143 in its low voltage state, Q144 is cut off. Since no current is flowing through Q144, its collector voltage is positive and forward biases Q154 and Q164. The conduction of Q154 forward biases. Disconnect diode D155 and provides turn on bias for VI61A in the Miller Runup circuit. The conduction of V161A establishes the operating point of cathode follower V173A. Diode D161, transistor Q164, and associated circuit elements form a feedback loop with the Miller circuit which under quiescent conditions clamps the sawtooth output bus at about +4 volts to provide a stable, repeatable sawtooth starting voltage.

Since Q144 is cut off under quiescent conditions, its collector voltage cuts off Q184. With Q184 cut off, its collector voltage cuts off V173B and Q194, permitting Q204 to conduct, blanking the crt and setting the voltage on the +GATE OUT connector to zero.

NORM, Sweep Triggered. When a trigger pulse is received from the Trigger Generator circuit, the trigger pulse supplies enough additional current to make tunnel diode D143 switch to its high voltage state. Once D143 switches to its high voltage state, the 3.8 ma current supplied to it is sufficient to keep it in its high voltage state when the trigger pulse ends.

The switching of D143 to its high voltage state biases Q144 into conduction, its collector voltage goes in a negative direction and cuts off Q154. When Q154 cuts off, the voltage on its collector goes negative and reverse biases Disconnect diode D155 but applies conduction bias to Q184. Q184 conducts, removes the negative voltage from the grid of V173B and at the same time biases Q194 into conduction. V173B unblanks the crt; Q194 generates a negative-going pulse whose positive going trailing edge can be used to switch channels in a multi-trace vertical plug-in unit. Since Q194 also cuts off Q204 at this time, the collector voltage of Q204 goes positive and generates the +GATE OUT pulse.

The negative-going step from Q154 reverse biases Disconnect diode D155 as previously explained. When D155 cuts off, the current through Timing Resistor R160 does not cease, but instead begins to charge Time Capacitor C160 (see Timing Switch schematic). As the timing capacitor charges, the grid of V161A goes negative. The tube amplifies the change in grid voltage and the inverted and greatly amplified change is applied to the grid of cathode follower V173A, which in turn couples the positive going voltage back to the timing capacitor and opposes the change in grid voltage of V161A. (The positive going voltage also reverse biases D161 and cuts off Q164). This action persists throughout the sawtooth period

and limits the total damage of grid voltage of V161A to less than 0.5 volt. Since the voltage drop across the timing resistor is held nearly constant, the current through the resistor is essentially a fixed value. This fixed current flows into the timing capacitor, producing a linearly increasing voltage (sawtooth) across the capacitor. The rate of the sawtooth rise is a function of the RC time constant of C160 and R160 and the voltage applied. D155 is a special diode that exhibits very low leakage under reverse-bias conditions. This characteristic prevents the diode from effectively altering the timing resistance value.

Since the rate of the sawtooth rise is a function of the RC time and the voltage applied, decreasing the voltage across the timing resistor decreases the current into the timing capacitor and therefore decreases the sawtooth rate of rise. The voltage across the timing resistor con be varied by turning the VARIABLE front panel control (R160W) shown on the Timing Switch schematic. This control permits the operator to obtain uncalibrated sweep rates at least two and one half times slower than the calibrated rates obtained with the control set in the CALIB position.

The sawtooth signal at the cathode of V173A is applied to the Horizontal Amplifier, and through R171 and D176 is also applied to the Holdoff circuit. The rising sawtooth voltage charges Holdoff capacitor C175 A-F. A point is finally reached where D179 is reverse biased and D178 is forward biased. Forward biasing D178 permits the sawtooth voltage to turn on Q135 in the Lockout Multi.

When Q135 conducts, it resets tunnel diode D143 to its low voltage state, turns off Q144, and ends the sweep. At this time the unblanking pulse and the +GATE OUT pulse are also terminated since V173B and Q194 are cut off by cutting off Q144 and Q184.

The time duration of the trigger pulses from the Trigger Generator, which switch D143 to its high voltage state and start the cycle of operation, will always be considerably less than the time duration of the sweep. However, once a sweep-gating trigger pulse switches D143 to its high-voltage state, additional trigger pulses can have no further effect on the operation. The tunnel diode reverts to its low-voltage state only when Q135 turns on.

The positive-going voltage step at the collector of Q144 that occurs when the Lockout Multi is switched and cuts Q144 off at the end of the sweep turns on Q154. The conduction of Q154 forward biases disconnect diode D155. Since the timing capacitor still holds the charge developed during the sweep, D161 remains back-biased. The timing capacitor begins to discharge through the current paths associated with R171 and R401. D161 does not conduct until the charge on the timing capacitor is nearly depleted.

The removal of the charge from the timing capacitor forms the retrace or falling portion of the output sawtooth. As the cathode voltage of V173A falls, D176 becomes reverse biased. During the sawtooth rise, holdoff capacitor C175 A-F charges through D176, but must now discharge through the high resistance of R175, R177, and R179. Thus while the timing capacitor discharges rapidly, restoring the Miller Runup circuit to quiescent conditions, the charge on the holdoff capacitor reverse biases D179 and the Lockout Multi cannot reset until the charge in the holdoff capacitor decreases.

When the sweep ends and the voltage on the cathode of V173A returns to its quiescent level, the voltage at the wiper arm of R173 is negative and reverse biases D178; D179 is reverse biased by the charge on the holdoff capacitor, and with both diodes non-conducting, Q135 remains in conduction. With Q315 conducting, D143 remains in its low voltage state and the sweep generator cannot be triggered since Q135 robs all the current from D143. Q135 remains in conduction until the charge on the holdoff capacitor is removed by current through R175 and R177. When the charge decreases to the point where D179 becomes forward biased, the negative going voltage is applied to the base of Q135 and causes the Lockout Multi to switch. Q125 becomes the conducting transistor and cuts off Q135. The entire sweep generator is now restored to quiescent conditions.

TRIGGERING LEVEL control R16B permits the operator to vary slightly the time between the completion of a sweep and the instant when the sweep generator again becomes triggerable. As Q135 turns off at the end of holdoff time, a very short but sometimes significant amount of time is required for the current through tunnel diode D143 to reach its quiescent level. When the relationship between the sweep rate and triggering frequency is such that the sweep gating trigger pulse tends to trigger each new sweep while the tunnel diode current is approaching the quiescent level, the display may jitter horizontally. The operator can minimize and often eliminate the jitter by slightly adjusting the TRIGGERING LEVEL control.

FREE RUN Mode. When the TRIGGER MODE switch is set to FREE RUN, sweep gating tunnel diode D143 is connected through L139, R116, and the TRIGGER MODE switch to +125 volts. This current path provides approximately 2.2 ma, which added to the approximately 3.8 ma through R144 and R145 is enough to bias D143 to its high voltage state. The high voltage state of D143 biases Q144 into conduction and starts the sweep as in the normal mode. When the sweep ramp voltage reaches the desired voltage, the Lockout Multi switches and Q135 robs all the current from D143, which resets D143 to its low voltage state and ends the sweep. At the end of holdoff time, the Lockout Multi resets and Q135 is cut off. Again there is sufficient current to bias D143 to its high voltage state, and a new sweep commences. Thus the completion of one cycle of operation causes the next to begin, and trigger pulses have no affect on the overall operation.

AUTO Mode. AUTO mode of operation is a combination of NORM and FREE RUN. If there are no trigger pulses coming from the Trigger Generator, the Sweep Generator and sweep gating tunnel diode D143 operate as if the TRIGGER MODE switch were in FREE RUN. The Auto Multi (Q105 and Q115) biases sweep gating tunnel diode D143 into its high voltage state, initiating a sweep. When the sweep reaches its peak value (as set by the SWEEP LENGTH control) the Lockout Multi switches and resets D143 to its low voltage state. The resetting of D143 ends the sweep. At the end of holdoff time, the Lockout Multi resets and again permits D143 to switch to its high voltage state, again initiating a sweep. The cycle repeats as long as no triggering signals are being received.

The arrival of a trigger pulse from the Trigger Generator switches the monostable Auto Multi to its unstable state, making Q105 the conducting transistor. The conduction of

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Q105 immediately removes the current through R115 from D143. This biases D143 to 3.8 ma and the circuit operates as if the TRIGGER MODE switch were in the NORM position. The Auto Multi remains in its unstable state for approximately 80 milliseconds or less. If a second trigger pulse is received during the time the Auto Multi is in its unstable mode, it switches sweep gating diodes D143 via D141 and initiates a sweep. This second trigger pulse also signals the Auto Multi to stay in its unstable state for an additional 80 milliseconds. As long as incoming trigger pulses arrive at intervals shorter than about 80 milliseconds, the sweep is triggered and operates as if the TRIGGER MODE switch were set to NORM. If the interval between incoming trigger pulses is longer than 80 milliseconds, the Auto Multi has time to return to its stable state, and the Sweep Generator resumes free-run operation. For this reason, the AUTO mode should not be used where the interval between trigger pulses exceeds 80 milliseconds.

Since the arrival of just one trigger pulse does not start a sweep, but merely removes the circuit from a free running condition, it is probable that the trigger pulse which switches the Auto Trigger Multi will arrive while a free-run initiated sweep is in progress. In this case the Sweep Generator cannot become triggerable until the end of the holdoff period for the sweep in progress, but from then on, every sweep will be a triggered sweep if the repetition rate of the incoming trigger pulse is greater than about 20 pulses per second. Whenever the period between trigger pulses exceeds 80 milliseconds, the Auto Trigger Multi reverts to its stable state and C105 charges up. With C105 charged, enough current is again available through R115 to switch D143 and free run the Sweep Generator.

The Auto Trigger Mutli incidentally controls the circuit which lights the single sweep READY and SWEEP TRIG'D lamps. In both the AUTO and NORM modes, the switching of the Auto Trigger Multi cuts off Q114. As the collector of Q114 rises toward the +125 volt source, the voltage increase lights the SWEEP TRIG'D lamp (B119).

SINGLE SWEEP Mode. As previously explained in the NORM Mode discussion, the Lockout Multi switches when the holdoff capacitor discharges after the retrace portion of the sweep. After the holdoff capacitor discharges down to where D179 becomes forward biased, the current through R175, R177, R124, R126 and R127 applies cutoff bias to Q135. However, in the SINGLE SWEEP mode of operation, R177 it connected to +125 volts, which serves to keep D179 reverse biased at all times. As the TRIGGER MODE switch is turned from NORM position to the SINGLE SWEEP position, switching transients trigger the sweep. As the sweep runs up, D178 becomes forward biased and makes Q135 the conducting transistor of the Lockout Multi. Since the +125 volts connected to R177 keeps D179 reverse biased, the Lockout Multi stays locked up with Q135 conducting. The conduction of Q135 diverts all current from D143 so that it cannot switch and start a sweep. To unlock the Lockout Multi, it is necessary to press the PUSH TO RESET switch (SW135). Pressing the PUSH TO RESET switch applies -100 volts through R137 to C136. When the voltage across C136 becomes great enough to fire neon bulb B135, the current through B135 and R135 generates a negative pulse which is coupled through C135 to the Base of Q135. The negative pulse cuts off Q135 and switches the Lockout Multi. With Q135 cut off, the current through R144 and R145 arms D143 so that it will switch to its high state whenever a trigger pulse is applied. The current through Q125 forward biases Q114 and turns on the READY lamp. The Sweep Generator will now deliver a single sweep upon the application of a trigger pulse.

Horizontal Amplifier

The block diagram in Section 5 shows the basic arrangement of the horizontal amplifier circuits. The input to the Horizontal Amplifier proper is taken from the output of cathode follower V173A in the Miller Runup circuit. Normally, the signal input to the Horizontal Amplifier is the sweep ramp voltage. However, when the TIME/DIV OR HORIZONTAL VOLTS/DIV switch is set to the EXT HORIZ IN position, the signal on the grid of V173A is taken from the External Horizontal Amplifier consisting of V161B and Q234.

As shown on the Sweep Generator schematic, the high impedance EXT HORIZ IN input is applied to cathode follower V161B which in turn drives common base amplifier Q234. Coupling between the input cathode follower and the common base stage is by means of a resistor string which includes the EXT HORIZ GAIN and VARIABLE controls. The EXT HORIZ GAIN control is a screwdriver adjustable control that is set during calibration. The VARIABLE control is an uncalibrated front panel control that permits the operator to decrease the sensitivity of any of the five SEC OR EXT VOLTS steps over a range from 1:1 to ≈ 2.5:1.

Referring to the Horizontal Amplifier schematic in Section 5, the input from the Miller Runup cathode follower is applied through R401, R402, and D411 to the base of input transistor Q414. SWP CAL control R402 provides a means of adjusting the amount of signal drive to the Horizontal Amplifier. Front panel FINE and POSITION controls apply dc voltages to the base of Q414, which in turn establishes the operating points of the transistors in the output stages of the Horizontal Amplifier. (Changing the dc level around which the transistors operate changes the position of the sweep on the crt screen.) Diodes D413, D414, and D415 protect Q414 from excessively large signals when externally generated horizontal input signals are used.

The output of Q414 is applied to the input of a paraphase amplifier consisting of Q424, Q434, Q423, Q433, and associated circuit elements. The two transistors in each side of the paraphase amplifier are compound connected to achieve the high effective gain needed to make the stage gain dependent only upon the coupling resistors between the two sides of the paraphase. The coupling network between the two sides of the paraphase include the SWP MAG REGIS resistor R422, the X50 MAG GAIN resistor R447, and the MAG resistors R340A to R340R. The coupling resistance value is about 920Ω when no magnification is used (X1) and is decreased to about 20Ω for X50 magnification (see Magnifier Switch Schematic).

The output of the paraphase amplifier drives the cathodes of a grounded-grid, push-pull connected twin triode (V444A and V444B). The push-pull output of the twin triode is applied through pins 17 and 21 of the interconnecting plug to the horizontal deflection plates of the crt.

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SECTION 4

MAINTENANCE AND CALIBRATION[1]

PREVENTIVE MAINTENANCE

Cleaning. Cleaning should precede calibration since the cleaning process could alter the setting of certain calibration controls.

Clean the instrument by vacuum and/or dry, low-pressure compressed air (high velocity air could damage certain components). Hardened dirt may be removed with a dry, soft point brush, cotton-tipped swab, or a cloth dampened with water and a mild detergent solution (such as Kelite or Spray White). Abrasive cleaners should not be used. Pay special attention to high-voltage circuits where conductive dust may create leakage paths.

Lubrication. The contacts on the plug-in interconnecting lack and plug should be lightly lubricated with on oil of the type used on switch contacts. To extend the life of the contacts, clean and relubricate if the oil becomes contaminated with abrasive dust. Keep a very light coating of grease (Beacon No. 325 or equivalent) on the rotary-switch detents.

Visual Inspection. After cleaning, the instrument should be carefully inspected for such defects as poor connections, broken or damaged ceramic terminal strips, improperly seated tubes or transistors, and heat damaged parts. The remedy for most visible defects is obvious; however, overheating is only a symptom of unseen defects or improper operation, and unless the cause of overheating is determined before parts are replaced, the damage may be repeated.

Tube and Transistor Checks. Periodic preventive maintenance checks on the tubes and transistors used in the instrument are not recommended. The circuits within the instrument generally provide the most satisfactory means of checking tube or transistor performance. Performance of the circuits is thoroughly checked during recalibration so that substandard tubes and transistors will usually be detected at this time.

Recalibration. To insure accurate measurements, the instrument calibration should be checked after each 500 hours of operation or every six months if used intermittently. Complete calibration instructions are contained later in this section.

The calibration procedure is helpful in isolating major troubles in the instrument. Moreover, minor troubles not apparent during regular operation may be revealed and corrected during calibration.

CORRECTIVE MAINTENANCE

General Information. Certain parts in the instrument are most easily replaced if definite procedures are followed as outlined in the following paragraphs.

Many electrical components are mounted in a particular way to reduce or control stray capacitance and inductance. When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect its performance at high frequencies. After repair, portions of the instrument may require recalibration.

Soldering. Special silver-bearing solder is used to establish a bond to the ceramic terminal strips in Tektronix instrument. This bond may be broken by repeated use of ordinary tin-lead solder or by excessive heating. We recommend solder containing about 3% silver. Silver-bearing solder is usually available locally.

Because of the shape of the ceramic-strip terminals it is recommended that a soldering iron with a wedge-shaped tip be used. A wedge-shaped tip allows the heat to be concentrated on the solder in the terminals and reduces the amount of heat required. It is important to use as little heat as possible while producing a full-flow joint.

The following procedure is recommended for removing or replacing components mounted on ceramic strips:

1. Use a 50- to 75-watt soldering iron.
2. Maintain a clean tip, properly tinned with solder containing about 3% silver.
3. Use long-nose pliers for a heat sink. Attach pliers between the component and the point where heat is applied.
4. Apply heat directly to the solder in the terminal without touching the ceramic. Do not twist the iron in the notch as this may chip or break the ceramic strip.
5. Apply only enough heat to make the solder flow freely.
6. Do not attempt to fill the notch on the strip with solder; instead apply only enough solder to cover the wires adequately and form a small fillet on the wire. Overfilling the notches may result in cracked terminal strips. If the lead extends beyond the solder joint, clip the excess as close to the joint as possible. Remove all wire clippings from the chassis.

Standard Parts. Many components in the instrument are standard electronic parts available locally.

Before purchasing or ordering, consult the Parts List (Section 5) to determine the value, tolerance, and ratings required.

Special Parts. Some parts are manufactured or selected by Tektronix to satisfy particular requirements, or ore manufactured for Tektronix to our specifications.

See "Parts Ordering Information" and "Special Notes and Symbols" on the first page of Section **6 and page 4-10**.

Ceramic Strip Replacement. Unsolder all connections, then use a 3/8" diameter by 3" long plastic or hardwood

[1] This procedure is to be used only for maintenance. For calibration procedure, see TB 750-236.

dowel and a small (2 to 4 oz.) mallet to knock the stud pins out of the chassis. Place one end of the dowel on the end of the stud pin protruding through the chassis and rap the opposite end of the dowel smartly with the mallet. When both studs of the strip to be removed have been loosened in this fashion, the strip is removed as a unit. The spacers will probably come out with the studs. If not, they can be pulled out separately. An alternate method of removing the terminal strip is to use diagonal cutters to cut off the side of the stud that holds the ceramic strip. The ceramic strip is removed and the studs pulled from the chassis with a pair of pliers. Replacement ceramic strips are supplied with studs and spacers and the old studs need not be salvaged.

When the damaged strip and stud assembly has been removed, place new spacers in the holes in the chassis. Using the mallet and dowel, tap the new stud pins down thoroughly in the spacers. Be sure that these pins are driven completely through the spacers. You may wish to cut off any portion of the stud pin that protrudes through the spacers with a pair of diagonal cutters. Fig. 4-1 shows how the parts of the ceramic terminal strip fit together.

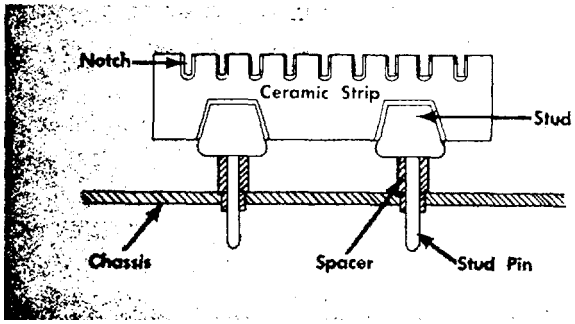

Fig. 4-1. Ceramic strip assembly.

Switch Replacement. Individual wafers normally are not replaced in switch assemblies. Replacement switches may be ordered from Tektronix either unwired or with the associated wires and components attached. See Parts List, Section 5.

When soldering leads to a switch, do not let solder flow around and beyond the terminal rivet as this may destroy the contact spring tension.

Troubleshooting Techniques. If the instrument is not operating, attempt to isolate the trouble by a quick operational and visual check. Make sure that any apparent trouble is actually due to a malfunction within the Type 3B4 and not to improper control settings or to a fault elsewhere in the oscilloscope system. Instructions for the operation of the Type 3B4 are contained in Section 2 of this manual. (Operating instructions for the other components of the oscilloscope system will be found in the instruction manuals for the individual components.)

Check the settings of all controls on the Type 3B4 and on the associated components of the oscilloscope system. A control set to the wrong position may cause what appears to be a trouble symptom. Operate the controls to see what effect, if any, they have on the trouble symptom. The normal or abnormal operation of each particular control helps in establishing the nature of the trouble. If a spare Type 3B4 is available, substitute the spare for the suspect unit and check for proper operation of the oscilloscope system. This is the best way to determine if the trouble is definitely in the Type 3B4.

If spare Type 3B4 units are not available, and the trouble symptoms are not definite, check the resistances at the pins of the interconnecting plug. Table 4-1 lists the normal resistances to ground for each pin. Typical voltages at various points inside the Type 3B4 and significant waveforms are shown on the various schematics in Section 5. The voltages shown may vary slightly from instrument to instrument.

TABLE 4-1

Interconnecting plug resistances to ground.

Terminal Number	Resistance to Ground	Use
1	80 Ω	6.3 AC
2	80 Ω	6.3 AC
3	Inf	Unused
4	5 K to 20 K	Multi trace sync pulse
5	0 Ω	GND
6	21.5 K	+300 V unregulated supply
7	Inf	Unused
8	Inf	Unused
9	0 Ω	GND
10	20 K	+300 V supply
11	Inf	Unused
12	1 meg[2]	Int trigger signal[2]
13	10 K to 20 K[1]	Unblanking pulse
14	4.8 K to 9.5 K[1]	+125 V supply
15	4.8 K to 9.5 K[1]	+125 V supply
16	50 Ω	-12.2 V supply
17	27 K[1]	Output
18	Inf	Unused
19	Inf	Unused
20	7 K to 11.5 K[1]	+125 V unregulated supply
21	26 K[1]	Output
22	0 Ω	GND
23	8.5 K to 11 K[1]	-100 V supply
24	Inf	Unused

[1] These readings depend upon the polarity of the meter leads and in some cases upon the resistance range used.

[2] Trigger COUPLING switch must be set to DC.
All readings taken with a 20,000 Ω/v multimeter.

All wiring used in the Type 3B4 is color coded to facilitate circuit tracing. In addition, all regulated power-supply leads are coded with specific color combinations for easy identification. In general, three stripes are placed on the wires which supply regulated power. The code used is the standard EIA number-color code. The first color (widest stripe) indicates the first number of the voltage on that lead. The second color indicates the second number of the lead voltage, and third color is a multiplier. The method is similar to that used in color coding resistors. Thus, the +100-volt leads are coded brown, black,

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brown. The voltage is positive if the body color of the wire is white and negative if the body color of the wire is tan.

Most troubles that occur in Tektronix instruments result from the failure of vacuum tubes or semiconductors. Once the trouble has been isolated to a particular area or circuit, check the tubes and semiconductors in the trouble area. Remember that when tubes or semiconductors fail, associated circuit components can be damaged.

Tube or transistor tester checks on the tubes or transistors used in the Type 3B4 ore not recommended. Testers may indicate a tube or transistor to be defective when it is operating satisfactorily in a circuit, or may fail to indicate tube or transistor defects which affect the performance of the circuits. It is recommended that tubes and transistors be checked by substitution. If the tube or transistor is good, return it to its socket. Unnecessary replacement of tubes or transistors is not only expensive but may also result in needless recalibration of the instrument.

CALIBRATION AND VERIFICATION

Recalibrate the Type 3B4 after each 500 hours of operation, or every six months if used intermittently. It may also be necessary to recalibrate certain sections of the instrument when tubes, transistors, or other components are replaced. Do not preset the internal adjustments. Presetting internal adjustments makes it necessary to completely recalibrate the instrument.

The following portion of this manual presents a calibration and verification procedure. The title of each numbered step begins either with "Adjust" or "Check"', thereby identifying the step function as calibration or verification. The steps arc identified in this manner because any or all groups of numbered “Checks” con be skipped without disrupting the continuity of the procedure. However, all adjustments must be completed in the order given and none should be skipped. Remember that proper overall operation is assured only when all steps in the procedure have been completed and all adjustments have been made as accurately as possible.

Steps 14, 15, 17, 21 and 26 may be used as an abridged adjustment procedure for adjusting all internal calibration potentiometers and sweep calibration capacitors.

NOTE

The performance standards described in this section of the manual are provided strictly as guides to calibration of the Type 3B4 and should not be construed as advertised performance specifications. However, if the Type 3B4 performs within the guide tolerances given in the calibration procedure, it will also perform as listed in the Characteristic section of this manual.

Equipment Required

1. Oscilloscope such as the Tektronix Type 561A. This procedure assumes that the power supply voltages in the oscilloscope are correct.
2. Tektronix 3-Series vertical plug-in unit such as the 3A1. This unit should be calibrated and operating in all respects.
3. Audio oscillator with output frequencies from 30 cps to 30 kc, 30 volts amplitude.
4. Constant-amplitude sine-wave generator such as the Tektronix Type 190A or 190B. Required characteristics: (a) output frequencies from 50 kc to 20 mc, (b) output voltage variable from about 0.3 volt to 4.0 volts peak-to-peak when terminated in 50Ω, and (c) provisions for maintaining constant amplitude (manually or automatically) with a change in frequency.
5. Time-mark generator such as the Tektronix Type 180A. Markers required at 1 and 5 sec; 100, 50, 10, and 1 msec; 100, 50, 10, 5, and 1 $m$sec; 5, 10, and 50 mc sine wave. All outputs should have a time accuracy of at least 0.1%.
6. Three 50Ω coax cables with BNC type connectors (Tektronix Part No. 012-057).
7. Tektronix 50 Ω BNC termination Part No. 011-049, 2 required.
8. UHF-BNC adapter, for connecting the Type 190A or 190B to the BNC termination (UG-255/U).
9. Plug-in extension, Tektronix Part No. 013-034.

1. Check Multi-Trace Operation

Set:

3A1 Controls	Setting
CH 1	
VOLTS/DIV	0.05
VARIABLE	CALIB
POSITION	Centered
AC DC GND	GND
MODE	ALTER
CH 2	
VOLTS/DIV	0.05
VARIABLE	CALIB
POSITION	Centered
AC DC GND	GND
3B4 Controls	**Setting**
TRIGGER MODE	FREE RUN
POSITION	Centered

Procedure:

Rotate the Type 561A INTENSITY control clockwise until the two traces appear. Set the Type 561A FOCUS control for minimum trace width. Rotate the Type 3B4 TIME/DIV switch through all sweep rates and check for 2 traces in each position.

2. Check TRIGGERING LEVEL Control Zero Set

Set:

3A1 Controls	Setting
MODE	CH 1
All other controls	unchanged

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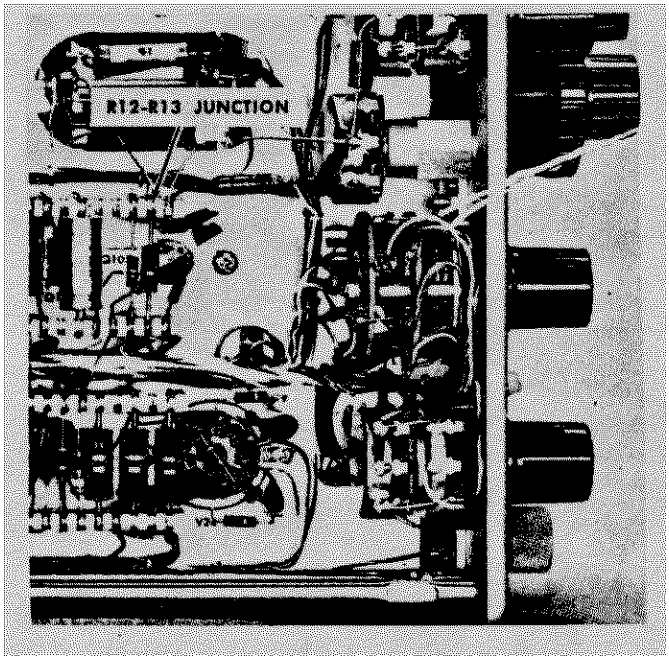


Fig. 4-2. Location of R12 and R13.

Procedure:

Remove the Type 3B4 from the Type 561A oscilloscope. Connect the Type 3B4 to the Type 561A by means of the plug-in extension (Tektronix part number 013-034). Connect the voltmeter positive lead to the junction of R12 and R13 (see Fig. 4-2) in the Type 3B4. Adjust the Type 3B4 TRIGGERING LEVEL for a reading of zero volts on the voltmeter. The knob index dot on the TRIGGERING LEVEL should be positioned at the front panel 0 when the voltmeter reads zero volts. If the control knob reads other than 0, loosen the set screw holding the control knob to the TRIGGERING LEVEL potentiometer. Return the knob index dot to the front panel 0 without changing the TRIGGERING LEVEL potentiometer. Check that the voltmeter continues to read zero. Tighten the TRIGGERING LEVEL knob set screw. Check that the voltmeter reads zero volts when the knob index dot is set at the front panel 0 position.

Reinstall the Type 3B4 in the oscilloscope.

3. Check Low Frequency Trigger Response

Set:

3A1 Controls	Setting
AC DC GND	AC
All Others	Unchanged
3B4 Controls	Setting
TIME/DIV	10 *m*SEC
TRIGGER MODE	FREE RUN
SOURCE	EXT
COUPLING	AC

Procedure:

Obtain a trace on the crt.

Connect a BNC "T" connector to the Type 3B4 EXT TRIG IN connector.

Connect a coax cable from the audio oscillator to the BNC "T" connector.

Connect a coax cable from the remaining side of the BNC "T" connector to the Type 3A1 CH 1 input.

Adjust the audio oscillator output for 3 major divisions of deflection (150 millivolts) at 30 cycles.

Change the Type 3B4 TIME/DIV switch to 10 mSEC.

Change the Type 3B4 TRIGGER MODE switch to NORM.

Using the TRIGGERING LEVEL control, check for proper external triggering (both AC and DC COUPLING and + and - SLOPE) with a 150-millivolt, 30 cycle input signal.

Check to see that the setting of the TRIGGERING LEVEL control is on the + side of 0 for a triggered waveform of + SLOPE and on the - side of 0 for a waveform of - SLOPE

Change the COUPLING switch to AC LF REJ. It should not be possible to trigger the Type 3B4 on a 150-millivolt, 30 cycle signal in the AC LF REJ position of the COUPLING switch.

4. Check EXT ÷ 10 Position of the SOURCE switch

Set:

3A1 Controls	Setting
VOLTS/DIV	0.5
3B4 Controls	Setting
SOURCE Switch	EXT ÷ 10

Procedure:

Adjust the Audio Oscillator for 3 major divisions of deflection (1.5 volts) of 30 cycle signal.

Repeat Step 3 using the new value of input voltage.

5. Check Internal Low Frequency Triggering

Set:

3B4 Controls	Setting
SOURCE Switch	INT

Procedure:

Set the audio oscillator output to give 0.5 minor division of deflection of 30 cycle signal.

Repeat Step 3 using this new setting of the SOURCE switch and audio oscillator output.

6. Check External Triggering Level Range

Set:

3A1 Controls	Setting
CH 1 VOLTS/DIV	10

Type 190B Controls	Setting
RANGE SELECTOR	50 kc
3B4 Controls	Setting
SOURCE	EXT
TIME/DIV	1 mSEC
MAGNIFIER	1 mSEC
COUPLING	DC
SLOPE	-

Procedure:

Set the audio oscillator to give 3 major divisions of 1 kc signal (30 volts).

Rotate the Type 3B4 TRIGGERING LEVEL control. Check to see that the sweep does not trigger at either extreme position of the control.

Change the SLOPE switch to +. Rotate the Type 3B4 TRIGGERING LEVEL control and check that the sweep does not trigger at either extreme position of the control.

7. Check Triggering in the AC LF REJ position of the COUPLING switch

Set:

3A1 Controls	Setting
CH 1 VOLTS/DIV	.05
3B4 Controls	Setting
TRIGGER MODE	FREE RUN
COUPLING	AC LF REJ
SOURCE	EXT
TIME/DIV	10 µSEC

Procedure:

Set the audio oscillator to give 3 major divisions of deflection (150 millivolts) at 30 kc.

Change the Type 3B4 TRIGGER MODE switch to NORM.

Check that a stable display can be obtained by carefully rotating the TRIGGERING LEVEL control.

8. Check Line Triggering

Set:

3A1 Controls	Setting
CH 1 VOLTS/DIV	5
3B4 Controls	Setting
TIME/DIV	10 mSEC
SOURCE	LINE
COUPLING	AC

Procedure:

Apply line voltage (available at the tip of the fuse holder in the Type 561A through a 10X probe to the CH 1 input of the Type 3A1.

With the TRIGGER MODE switch set to NORM, it should be possible to obtain a triggered display by adjusting the TRIGGERING LEVEL control. Polarity of the triggered waveform must correspond to the setting of the SLOPE switch.

Remove the probe from the Type 561A fuse holder.

9. Check High Frequency Trigger Response

Set:

3A1 Controls	Setting
CH 1 VOLTS/DIV	.05
3B4 Controls	Setting
TRIGGER MODE	FREE RUN
TIME/DIV	.2 mSEC
MAGNIFIER	.2 mSEC
SOURCE	EXT
Type 190B Controls	Setting
RANGE SELECTOR	50 kc

Procedure:

Remove the Audio Oscillator coax cable from the BNC "T" connector and connect the Type 190B ATTENUATOR to the "T" connector. Insert a 50 Ω termination (Tektronix Part No. 011-049) between the "T" connector and the EXT TRIG IN connector.

Adjust the Type 190B ATTENUATOR and OUTPUT AMPLITUDE for 3 major divisions of deflection.

NOTE

The specified bandpass of the Type 3A1 Dual Trace Amplifier is 10 mc. To check the external triggering high frequency response, it is necessary to use a constant amplitude sine wave generator, using the Type 3A1 to set the amplitude at some frequency much lower than 10 mc (e.g., 50 kc).

Change the Type 190B RANGE SELECTOR and RANGE IN MEGACYCLES to give a 20 mc output signal.

Change the Type 3B4 TIME/DIV switch to .2 mSEC.

Change the Type 3B4 TRIGGER MODE switch to NORM.

With 150 millivolts of 20 mc signal applied to the EXT TRIG IN connector, check triggering in AC, AC LF REJ, and DC, both + and - positions of the SLOPE switch.

10. Check EXT ÷ 10 High Frequency Triggering

Set:

3B4 Controls	Setting
SOURCE	EXT ÷ 10
TRIGGER MODE	FREE RUN
3A1 Controls	Setting
CH 1 VOLTS/DIV	.5

Procedure:

Using the Type 190B ATTENUATOR and OUTPUT AMPLITUDE obtain a display of 3 major divisions (1.5 volts) of 50 kc signal.

Change the Type 190B RANGE SELECTOR and RANGE IN MEGACYCLES for a 20 mc signal.

Change the Type 3B4 TRIGGER MODE switch to NORM.

Check triggering in AC, AC LF REJ and DC, in both + and - positions of the SLOPE switch.

11. Check Internal High Frequency Triggering

Set:

3B4 Controls	Setting
TRIGGER MODE	FREE RUN
SOURCE	INT

Procedure:

Using the Type 190B ATTENUATOR and OUTPUT AMPLITUDE controls, obtain a vertical display of 1 minor division of 20 mc signal.

Change the Type 3B4 TRIGGER MODE switch to NORM.

Check triggering in AC, AC LF REJ and DC in both + and - positions of the SLOPE switch.

Change the Type 3B4 TRIGGER MODE switch to FREE RUN and set the COUPLING switch to DC.

Using the Type 3A1 CH 1 POSITION control, position the display at the top of the graticule.

Change the Type 3B4 TRIGGER MODE switch to NORM.

Set the TRIGGERING LEVEL control for a stable display.

Check triggering in both the + and - positions of the SLOPE switch.

Change the Type 3B4 TRIGGER MODE switch to FREE RUN.

Position the display at the bottom of the graticule.

Change the Type 3B4 TRIGGER MODE switch to NORM.

Check triggering in both the + and - positions of the SLOPE switch.

12. Check Auto Trigger Operation

Set:

3B4 Controls	Setting
COUPLING	AC
SOURCE	INT
TRIGGER MODE	AUTO
TIME/DIV	10 µSEC
Type 180A Controls	**Setting**
	50 MILLISECOND markers

Procedure:

Connect a coax cable from the Type 180A MARKERS jack to the Type 3A1 CH 1 input connector.

Set the Type 3A1 VOLTS/DIV switch to give approximately two major divisions of deflection.

Position the display so the start of the trace is near the center of the graticule.

Rotate the TRIGGERING LEVEL control to obtain a stable display of a portion of the leading edge of the marker.

Change the Type 180A to 100 Millisecond markers.

Note that the sweep will not trigger on 100 millisecond markers as it did on 50 millisecond markers.

13. Check Single Sweep Operation

Set:

3B4 Controls	Setting
TRIGGER MODE	NORM
TIME/DIV	100 mSEC

Procedure:

Using the TRIGGERING LEVEL control, obtain a stable display.

Change the Type 3B4 TIME/DIV switch to 1 SEC.

Change the Type 180A to 1 second markers.

Observe the display for several traces and note that it is triggered correctly.

Change the TRIGGER MODE switch to SINGLE SWEEP.

Wait until the READY light extinguishes and the SWEEP TRIG'D light is lit.

Press the PUSH TO RESET button and observe the crt; a single display should occur.

After the single display, the ready light should extinguish and the SWEEP TRIG'D light should light.

NOTE

The SWEEP TRIG'D indicator lights when the Sweep Generator is triggered by the Trigger Generator. At slow trigger signal repetition rates, this is indicated by the light flashing each time a trigger is applied to the Sweep Generator. At faster triggering signal repetition rates the light appears to remain on at all times. During Single Sweep Operation the SWEEP TRIG'D light is locked out during the time that the Lockout Multi is armed.

14. Adjust Sweep Calibration

Set:

3A1 Controls	Setting
MODE	CH 1
CH 1 VOLTS/DIV	2
POSITION	Centered

3B4 Controls	Setting
TIME/DIV	1 mSEC
SOURCE	INT
COUPLING	AC
SLOPE	+
TRIGGER MODE	AUTO

Procedure:

Apply 1 millisecond markers from the Type 180A to the CH 1 input.

Use the Type 3B4 POSITION and FINE controls to align the first time mark (not the zero mark, see Fig. 4-3) with the second graticule line.

Adjust the CALIBRATE control (front-panel screwdriver adjustable control) until the first and ninth time markers are centered on the second and tenth graticule lines. The maximum allowable error for this step is ±3% over the center 8 major divisions, however, it is usually possible to calibrate much more accurately than this.

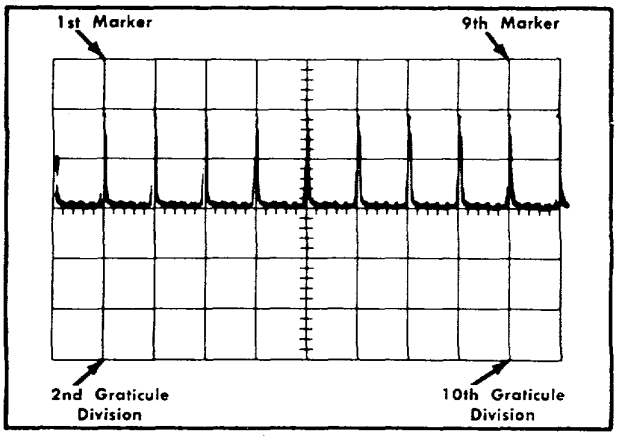


Fig. 4-3. Counting of time marker and graticule divisions.

NOTE

The CALIBRATE adjustment provides a range of ±10% when the horizontal deflection sensitivity of the crt is 18.6 v/div. If the crt horizontal deflection sensitivity is other than 18.6 v/div, the + and - percentages differ.

15. Adjust Magnifier Calibration and Sweep Magnifier Registration

Set:

3B4 Controls	Setting
MAGNIFIER	20 µSEC
Other Controls	unchanged

Procedure:

Apply 10 microsecond markers from the Type 180A to the Type 3A1 CH 1 input. Using the Type 3B4 POSITION and FINE controls, align the markers with graticule major division lines.

Adjust the X50 MAG GAIN adjustment (R447) for 2 time marks per major division. The maximum allowable error for this step is ±5% over the center eight major divisions, however, it is usually possible to calibrate much more accurately than this.

Using the Type 3B4 POSITION and FINE controls, position the first time marker on the graticule center line. Switch the Type 3B4 MAGNIFIER switch to 1 mSEC and adjust the SWP MAG REGIS (R422) so that the first marker again falls on the center graticule line.

NOTE

The CALIBRATE, X50 MAG GAIN, and SWP MAG REGIS adjustments interact. Repeat Step 14 and then Step 15 until all three controls are accurately adjusted.

16. Check 2 mSEC and 5 mSEC Timing Accuracy

Set:

3B4 Controls	Setting
TIME/DIV	2 mSEC
MAGNIFIER	2 mSEC

Procedure:

Apply 1 millisecond markers from the Type 180A and check for 2 marks per major division. Maximum allowable error is ±3% (1.2 minor divisions).

Switch the TIME/DIV and MAGNIFIER switches to 5 mSEC.

Apply 5 millisecond markers from the Type 180A and check for 1 mark per major division. Maximum allowable error is ±3%.

17. Adjust Sweep Length

Set:

3B4 Controls	Setting
TIME/DIV	1 mSEC

Procedure:

Apply 1 millisecond and 100 microsecond markers simultaneously from the Type 180A. Position the display to the left with the POSITION control so that the 10th (not counting the first marker on the left-see Fig. 4-3) large (millisecond) marker is one major division in from the right side of the graticule. Adjust LENGTH control R173 for 5 small (100 microsecond) markers following the 10th large marker.

18. Check Variable Time Per Division

Procedure:

With the Type 3B4 TIME/DIV and MAGNIFIER switches set to 1 mSEC, apply 1 millisecond markers only from the Type

180A. Position the display for 1 marker per major division. Rotate the VARIABLE control from the CALIB position to the full counterclockwise position and check for 5 or more markers per two major divisions. Note that the UNCAL light illuminates whenever the VARIABLE control is switched from the UNCAL position.

19. Check Timing Accuracy of Magnified Sweep

Procedure:

Set controls and check timing over center 8 major divisions of graticule as listed in Table 4-2. Maximum allowable error is 5% (2 minor divisions).

TABLE 4-2

TIME/DIV Setting	MAGNIFIER Setting	TYPE 180A Signal	Marks per cm
1 mSEC	.5 mSEC	500 μSEC	1
1 mSEC	.2 mSEC	100 μSEC	2
1 mSEC	.1 mSEC	100 μSEC	1
1 mSEC	50 μSEC	50 μSEC	1
1 mSEC	20 μSEC	10 μSEC	2
5 mSEC	2 mSEC	1 mSEC	2
5 mSEC	.2 mSEC	100 μSEC	2
2 mSEC	.5 mSEC	500 μSEC	1
2 mSEC	50 μSEC	50 μSEC	1

20. Check Slow and Medium Sweep Timing

Procedure:

Set controls and check timing as listed in Table 4-3. Maximum allowable error 3% (1.2 minor divisions).

Leave the MAGNIFIER switch locked to the TIME/DIV switch. (The 1, 2, and 5 mSEC/DIV settings are omitted from the table. They are checked in Steps 15 and 16.)

TABLE 4-3

TIME/DIV Setting	TYPE 180A Signal	Marks Per div
.1 mSEC	100 μSEC	1
.2 mSEC	100 μSEC	2
.5 mSEC	500 μSEC	1
10 mSEC	10 mSEC	1
20 mSEC	10 mSEC	2
50 mSEC	50 mSEC	1
Change TRIGGER MODE to NORM		
.1 SEC	100 mSEC	1
.2 SEC	100 mSEC	2
.5 SEC	500 mSEC	1
1 SEC	1 SEC	1
2 SEC	1 SEC	2

Change the Type 3B4 TIME/DIV switch to 5 SEC.

Change the Type 180A to 5 second markers. Check the display for 1 marker per major division. Maximum allowable error ±5% (2 minor divisions) between the 2nd and 10th graticule marks.

21. Adjust Fast Sweep Timing

Procedure:

Change the Type 180A to 10 microsecond markers.

Change the Type 3B4 TIME/DIV switch to 10 μSEC and adjust the TRIGGERING LEVEL for a stable display.

Position the first marker on the second graticule mark as shown in Fig. 4-3.

Adjust C160 for time marker per division.

Change the Type 180A to deliver a 5 mc sinewave.

Change the Type 3B4 TIME/DIV switch to .2 μSEC.

Position the first cycle on the second graticule line. Adjust C160A for 1 cycle per major division.

22. Check Fast Sweep Rate Timing Accuracy

Procedure:

Using the outputs listed in the first column of Table 4-4, set the TIME/DIV switch as listed in the second column and check for the proper number of markers as listed in the third column. The allowable error is 1.2 minor divisions over the center eight major divisions.

TABLE 4-4

Type 180A	TIME/DIV	Marks/Div
5 Mc Sinewave	.2 μSEC	1 cycle/div
1 microsecond	.5 μSEC	1 mark/2 div
1 microsecond	1 μSEC	1 mark/div
1 microsecond	2 μSEC	2 marks/div
5 microsecond	5 μSEC	1 mark/div
10 microsecond	10 μSEC	1 mark/div
10 microsecond	20 μSEC	2 marks/div
50 microsecond	50 μSEC	1 mark/div

23. Check Magnified Fast Sweep Rates

Set:

3B4 Controls	Setting
TIME/DIV	.2 μSEC
MAGNIFIER	.05 μSEC

Procedure:

Apply a 10 mc sine wave from the Type 180A to the CH 1 input.

Adjust the Type 3B4 TRIGGERING LEVEL for a stable display.

Check the magnified fast sweep rates at the start, middle, and end of the sweep, excluding the specified portion at the start of the sweep as listed in Table 4-5; at the end of the sweep, exclude everything outside the 9th major division of the **unmagnified** sweep.

Check the other sweep magnification combinations as listed in Table 4-5. Maximum allowable error is 2 minor divisions.

TABLE 4-5

TIME/DIV	MAGNI-FIER	TYPE 180A	Exclude	Cycles/DIV
.2 mSEC	.05 mSEC	10 mc	1 cycle	1 cycle/2 div
.2 mSEC	.1 mSEC	10 mc	5 cycles	1
.5 mSEC	.05 mSEC	10 mc	5 cycles	1 cycle/2 div
.5 mSEC	.1 mSEC	10 mc	5 cycles	1
.5 mSEC	.2 mSEC	10 mc	S cycles	2
1 mSEC	.05 mSEC	10 mc	5 cycles	1 cycle/2 div
1 mSEC	.1 mSEC	10 mc	5 cycles	1
1 mSEC	.2 mSEC	10 mc	5 cycles	2
1 mSEC	.5 mSEC	1 mSEC	1 marker	1 mark/2 div
2 mSEC	.05 mSEC	10 mc	5 cycles	1 cycle/2 div
2 mSEC	.1 mSEC	10 mc	5 cycles	1
2 mSEC	.2 mSEC	10 mc	5 cycles	2
2 mSEC	.5 mSEC	1 mSEC	1 marker	1 mark/2 div
2 mSEC	1 mSEC	1 mSEC	1 marker	1 mark/div
5 mSEC	.1 mSEC	10 mc	5 cycles	1
5 mSEC	.2 mSEC	5 mc	4 cycles	1
5 mSEC	.5 mSEC	1 mSEC	1 marker	1 mark/2 div
5 mSEC	1 mSEC	1 mSEC	1 marker	1 mark/1 div
5 mSEC	2 mSEC	1 mSEC	1 marker	2 marks/div

24. Check +GATE OUT

Procedure:

Remove the input cable from the Type 3A1 CH 1 input connector

Set the Type 3B4 TRIGGER MODE switch to FREE RUN and connect a test oscilloscope 10X probe to the + GATE OUT connector of the Type 3B4. Check that the output amplitude of the + GATE pulse is 20 volts ±10%.

25. Check +GATE Interval

Procedure:

Turn the Type 3B4 TRIGGERING LEVEL control to 0. With the test oscilloscope probe still connected to the +GATE OUT connector, measure the time between +GATE pulses as listed in Table 4-6.

TABLE 4-6

TIME/DIV	+GATE INTERVAL
0.2 mSEC—2.0 mSEC	45—8 mSEC
5.0 mSEC—20 mSEC	9.5—13.5 mSEC
50 mSEC—0.2 mSEC	60—110 mSEC
0.5 mSEC—2.0 mSEC	450—700 mSEC
5.0 mSEC—20 mSEC	4.5—13.5 mSEC
50 mSEC—5 SEC	45—65 mSEC

NOTE

The time interval between +GATE pulses includes holdoff time and re-cycle time. For this reason the term "+GATE INTERVAL" is used here instead of "holdoff time". The TRIGGERING LEVEL control provides a 5% to 10% variation in the +GATE interval.

26. Adjust External Horizontal Gain

Procedure:

Turn the Type 3B4 TIME/DIV switch to EXT HORIZ IN. Pull out the MAGNIFIER knob and set the index dot to .2 SEC OR EXT VOLTS.

Apply 1 volt (±0.3%) square wove signal to the Type 3B4 EXT HORIZ IN connector. The frequency of the square wave should be between 50 cycles and 2 kc.

NOTE

Any error in the amplitude of the square wave signal will be added to the 3% tolerance of the Type 3B4. For this reason it is important that the voltage of the calibrating signal used for this step be accurate within ± 0.3%.

Adjust EXT HORIZ GAIN control R228 for 5 major divisions of deflection, ±0.5 minor divisions.

27. Check External Horizontal Attenuator Accuracy

With the equipment set up as in Step 26, apply the voltages listed in the first column of Table 4-7 and check for the proper deflection in each setting of the EXT VOLTS positions of the MAGNIFIER knob listed.

TABLE 4-7

EXT VOLTS setting	Square Wave Voltage ±0.3 %	Deflection in major divisions	Maximum Allowable error
.2 VOLTS	1 VOLT	5	.75 minor div
.5 VOLTS	2 VOLTS	4	.6 minor div
1 VOLT	5 VOLTS	5	.75 minor div
2 VOLTS	10 VOLTS	5	.75 minor div
5 VOLTS	20 VOLTS	4	.6 minor div

28. Check External Horizontal VARIABLE Attenuator

Procedure:

With the equipment set up as in Step 27, set the MAGNIFIER knob to the 2 volt position of the SEC OR EXT VOLTS range. Apply a 10-volt square wave signal to the EXT HORIZ IN connector.

Rotate the VARIABLE control fully counterclockwise. Check for 2 major divisions or less of horizontal deflection.

29. Check Horizontal Position Range

Procedure:

Turn the MAGNIFIER knob to the 5 EXT VOLTS position. Increase the square wave input to 20 volts. Using the POSITION control, it should be possible to position the display off the crt fact at either end.

Turn the FINE control fully clockwise. With the POSITION control, position the right hand end of the display on a major graticule line. Now rotate the FINE control fully counterclockwise; the display should shift from 0.9 to 1.4 major division.

30. Check External Horizontal Bandpass

Set:

3B4 Controls	Setting
TIME/DIV	EXT HORIZ IN
VARIABLE	CALIB
MAGNIFIER	.2 EXT VOLTS

Type 190B Controls	Setting
RANGE SELECTOR	50 KC

Procedure:

Connect the Type 190B Attenuator to the Type 3B4 EXT HORIZ IN connector. Adjust the Type 190B ATTENUATOR and OUTPUT AMPLITUDE controls for a horizontal deflection of 8 major divisions.

Change the Type 190B RANGE SELECTOR switch to .35 to .75 MEGACYCLES.

Turn the Type 190B RANGE IN MEGACYCLES control until the crt display shrinks to 5.6 major divisions (30% down points). Check that the Type 190B RANGE IN MEGACYCLES dial reads .40 megacycles or above.

PARTS PROVISIONING LIST

REPLACEMENT PARTS

To obtain replacement parts, find the manufacturer's part number and description in this manual and then refer to the appropriate Repair Parts and Special Tools List (RPSTL) TM. In the RPSTL, find the assembly or subassembly first and then the description which corresponds with that in this manual. Under the description in the RPSTL find the manufacturer's part number, and then order the part by the listed Federal Stock Number. If the part is not listed in the RPSTL, it should be requisitioned from the NICP in accordance with AR 725-50.

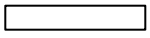
SECTION 5

PARTS LIST and DIAGRAMS

ABBREVIATIONS AND SYMBOLS

a or amp	amperes	mm	millimeter
BHS	binding head steel	meg or M	megohms or mega (10^6)
C	carbon	met.	metal
cer	ceramic	μ	micro, or 10^6
cm	centimeter	n	nano, or 10^{-9}
comp	composition	Ω	ohm
cps	cycles per second	OD	outside diameter
crt	cathode-ray tube	OHS	oval head steel
CSK	counter sunk	p	pico, or 10^{-12}
dia	diameter	PHS	pan head steel
div	division	piv	peak inverse voltage
EMC	electrolytic, metal cased	plstc	plastic
EMT	electrolytic, metal tubular	PMC	paper, metal cased
ext	external	poly	polystyrene
f	farad	Prec	precision
F & I	focus and intensity	PT	paper tubular
FHS	flat head steel	PTM	paper or plastic, tubular, molded
Fil HS	fillister head steel	RHS	round head steel
g or G	gigo, or 10^9	rms	root mean square
Ge	germanium	sec	second
GMV	guaranteed minimum value	Si	silicon
h	henry	S/N	serial number
hex	hexagonal	t or T	tera, or 10^{12}
HHS	hex head steel	TD	toroid
HSS	hex socket steel	THS	truss head steel
HV	high voltage	tub.	tubular
ID	inside diameter	v or V	volt
incd	incandescent	Var	variable
int	internal	w	watt
k or K	kilohms or kilo (10^3)	w/	with
kc	kilocycle	w/o	without
m	milli, or 10^{-3}	WW	wire-wound
mc	megacycle		

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number.
000X	Part removed after this serial number.
*000-000	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, or reworked or checked components.
Use 000-000	Part number indicated is direct replacement.
	Internal screwdriver adjustment.
	Front-panel adjustment or connector.

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EXPLODED VIEW

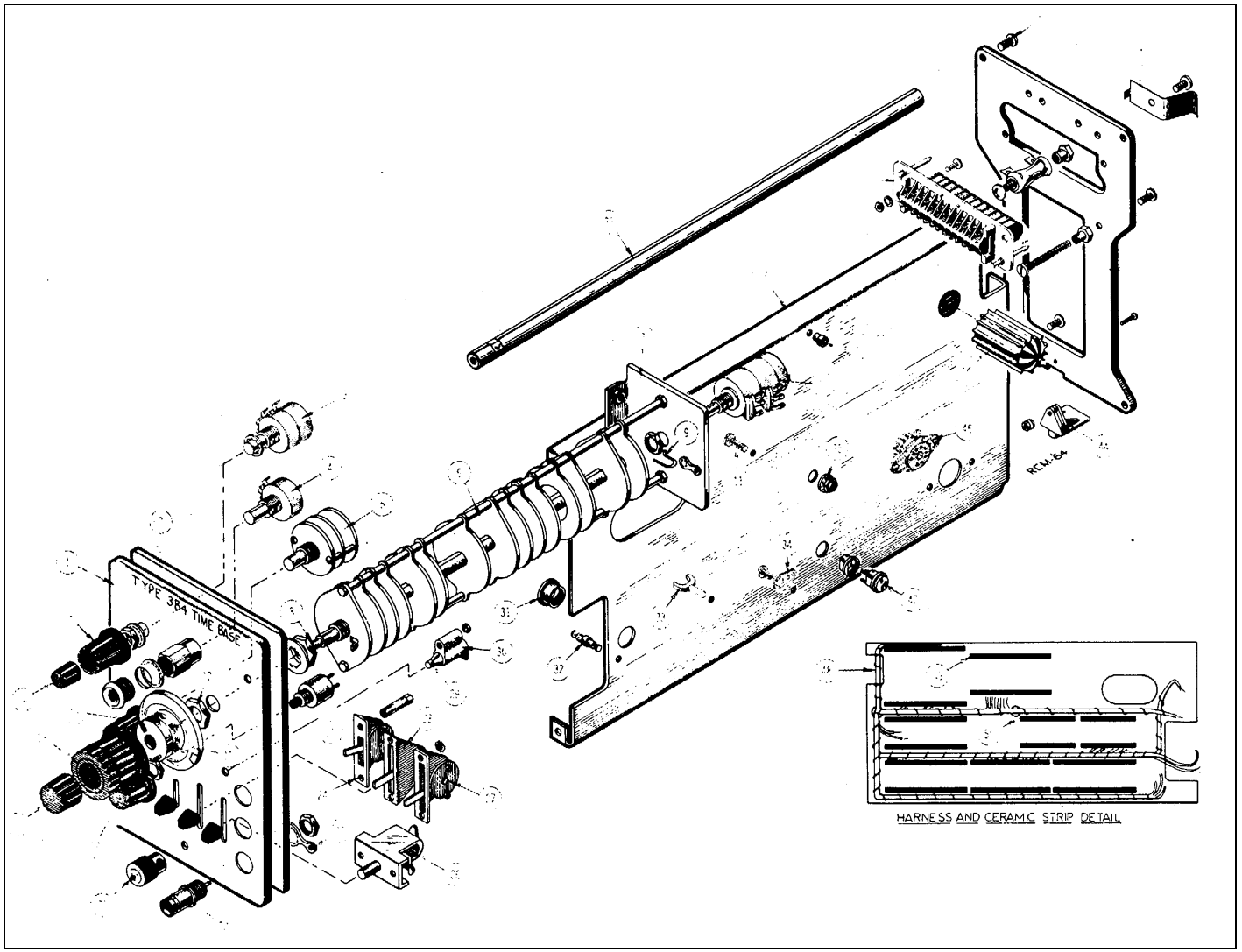

Figure 5-1

(A)

EXPLODED VIEW

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY	DESCRIPTION
1	333-843			1	PANEL, front
	- - - -			-	mounting hardware: (not included w/panel)
	213-055			1	SCREW, thread forming, 2-32 x 3/16 inch, PHS phillips
2	387-974			1	PLATE, sub-panel
3	- - - -			2	POT
	- - - -			-	mounting hardware for each: (not included w/pot)
	210-012			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-840			1	WASHER, .390 ID x 9/16 inch OD
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
4	- - - -			1	POT
	- - - -			-	mounting hardware (not included w/pot)
	210-494			1	NUT, hex, 3/8-32 x 1/2 x 11/16 inch
	210-012			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	358-010			1	BUSHING, 3/8-32 x 9/16 inch
5	260-623			1	SWITCH, unwired - TRIGGER MODE
	- - - -			-	mounting hardware: (not included w/switch)
	210-012			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-840			1	WASHER, .390 ID x 9/16 inch OD
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
6	262-669			1	SWITCH, wired - TIME/CM (See Ref. #11 & #12)
	- - - -			-	switch includes:
	260-624			1	SWITCH, unwired - TIME/CM
	- - - -			-	switch includes
7	406-882			1	BRACKET, switch
	- - - -			-	mounting hardware: (not included w/bracket alone)
	210-004			1	LOCKWASHER, internal, #4
	210-203			1	LUG, solder, #6 long
	210-449			2	NUT, hex, 5-40 x 1/4 inch
8	384-321			1	ROD, switch
9	376-014-00			1	COUPLING, pot
10	- - - -			1	POT
	- - - -			-	mounting hardware: (not included w/pot alone)
	210-012			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
	- - - -			-	mounting hardware: (not included w/switch)
11	211-504			2	SCREW, 6-32 x 1/4 inch, BHS
12	210-579			1	NUT, hex, 5/8-24 x 3/4 inch
	210-049			1	LOCKWASHER, internal, 5/8 inch
13	366-269			1	KNOB, large charcoal - TIME/CM
	- - - -			-	knob includes:
	213-022			2	SCREW, set, 4-40 x 3/16 inch, HSS
14	366-255			1	KNOB, small -red - FINE
	- - - -			-	knob includes:
	213-020			1	SCREW, set, 6-32 x 1/8 inch, HSS

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EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY	DESCRIPTION
15	366-0173-00			1	KNOB, charcoal — TRIGGER MODE
	- - - - - -			-	knob includes
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
16	366-0138-00			1	KNOB, charcoal — POSITION
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set 6-32 x 3/16 inch, HSS
17	366-0038-00			1	KNOB, small red — VARIABLE
	- - - - - -			-	knob includes
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
18	366-0173-00			1	KNOB, charcoal — TRIGGERING LEVEL
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set 6-32 x 3/16 inch, HSS
19	331-0132-00			1	DIAL, window knob
	- - - - - -			-	dial includes:
	213-0022-00			2	SCREW, set 4-40 x 3/16 inch, HSS
20	366-0215-00	100	789	3	KNOB, lever
	366-0215-01	790		3	KNOB, lever
21	366-0109-00			1	KNOB, plug-in securing
	- - - - - -			-	knob includes:
	213-0005-00			1	SCREW, set, 8-32 x 1/8 inch
22	131-0106-00			3	CONNECTOR, chassis mounted, 1 contact, BNC
23	210-0255-00			3	LUG, solder
24	260-0472-00			1	SWITCH, lever — SLOPE
	- - - - - -			-	mounting hardware: (not included w/switch)
	220-0413-00			2	NUT, switch, 4-40 x 3/16 x .500 inch long
25	260-0518-00			1	SWITCH, push-pull w/red indicator light
	- - - - - -			-	mounting hardware: [not included w/switch)
	210-0590-00			1	NUT, hex, 3/8-32 x 7/16 inch
26	214-0052-00			1	FASTENER, pawl right w/stop
	- - - - - -			-	mounting hardware: (not included w/fastener)
	210-0004-00			2	LOCKWASHER, internal, #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
27	260-0615-00			1	SWITCH, lever — SOURCE
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0586-00			2	NUT, keps, 4-40x 1/4 inch
28	260-0594-00			1	SWITCH, lever — COUPLING
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0586-00			2	NUT, keps, 4-40x 1/4 inch
29	378-0541-00			2	FILTER, lens, neon indicator light
30	352-0067-00			2	HOLDER, single neon
	- - - - - -			-	mounting hardware for each: (not included w/holder)
	211-0031-00			1	SCREW, 4-40 x 1 inch, FHS
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
31	348-0063-00			3	GROMMET, plastic, 1/2 inch
32	131-0182-00			2	CONNECTOR, terminal feedthru
	- - - - - -			-	mounting hardware for each: (not included w/connector)
	358-0135-00			1	BUSHING, teflon

EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY	DESCRIPTION
33	426-121			1	MOUNT, toroid
	- - - -			-	mounting hardware (not included w/mount)
	361-007			1	SPACER, nylon, .063 inch
34	210-201			9	LUG, solder, SE #4
	- - - -			-	mounting hardware for each: (not included w/lug)
	213-044			1	SCREW, thread cutting, 5-32 x 3/16 inch, PHS phillips
35	- - - -			4	POT, miniature
	- - - -			-	mounting hardware for each: (not included w/pot)
	210-940			1	WASHER, 1/4 ID x 3/8 inch OD
	210-583			1	NUT, hex, 1/4-32 x 5/16 inch
36	348-031			1	GROMMET, snap-in
37	384-615			4	ROD, frame
38	441-579			1	CHASSIS, plug-in
	- - - -			-	mounting hardware: (not included w/chassis)
	211-507			3	SCREW, 6-32 x 5/16 inch, BHS
	211-538			3	SCREW, 6-32 x 5/16 inch, FHS phillips
	210-457			2	NUT, keps, 6-32 x 5/16 inch
39	131-149			1	CONNECTOR, chassis mounted, 24 contact
	- - - -			-	mounting hardware: (not included w/connector
	211-008			2	SCREW, 4-40 x 1/4 inch, BHS
	210-004			1	LOCKWASHER, internal, #4
	210-201			1	LUG, solder, SE #4
	210-406			2	NUT, hex, 4-40 x 3/16 inch
40	- - - -			2	RESISTOR, 5 watt
	- - - -			-	mounting hardware for each: (not included w/resistor)
	211-544			1	SCREW, 6-32 x 3/4 inch, THS phillips
	210-478			1	NUT, hex, resistor mounting
	211-507			1	SCREW, 6-32 x 5/16 inch, BHS
41	214-276			2	SPRING, ground
	- - - -			-	mounting hardware for each: (not included w/spring)
	211-507			1	SCREW, 6-32 x 5/16 inch, BHS
42	387-647			1	PLATE, rear
	- - - -			-	mounting hardware: (not included w/plate)
43	212-044			4	SCREW, 8-32 x 1/2 inch, RHS phillips
44	351-037			1	GUIDE, plug-in
	- - - - -			-	mounting hardware: (not included w/guide)
	211-012			1	SCREW, 4-40 x 3/8 inch, BHS
	210-004			1	LOCKWASHER, internal, #4
	210-406			1	NUT, hex, 4-40 x 3/16 inch
45	337-649			1	SHIELD, heat dissipating
46	136-015			4	SOCKET, STM9G
	- - - -			-	mounting hardware for each: (not included w/socket)
	213-044			2	SCREW, thread cutting, 5-32 x 3/16 inch, PHS phillips

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EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY	DESCRIPTION
47	136-0181-00			19	SOCKET, 3 pin transistor
	- - - - - - -			-	mounting hardware for each: (not included w/socket)
	354-0234-00			1	RING, locking, transistor socket
48	179-0924-00			1	CABLE HARNESS, chassis
49	124-0145-00			12	STRIP, ceramic, 7/16 inch x 20 notches
	- - - - - -			-	each strip includes
	355-0046-00			2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, nylon, .313 inch
50	124-0147-00			4	STRIP, ceramic, 7/16 inch x 13 notches
	- - - - - - -			-	each strip includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, nylon, .313 inch
					STANDARD ACCESSORIES
	070-0431-00			2	MANUAL instruction (not shown)

ELECTRICAL PARTS

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description	S/N Range
		Bulbs	
8118†	260-518	Switch w/red Indicator Light	READY
B119	150-027	Neon, NE-23	SWEEP TRIG'D
8135	150-027	Neon, NE-23	
8160X	150-027	Neon, NE-23	UNCAL
		Capacitors	
Tolerance ±20% unless otherwise indicated.			
C1	281-538	1 pf Cer 500 v	
C5	283-013	0.01 mf Cer 1000 v	
C6	281-523	100 µf Cer 350 v	
C10	283-000	0.001 mf Cer 500 v	
C12	283-003	0.01 mf Cer 150 v	
C19	283-003	0.01 pf Cer 150 v	
C31	283-003	0.01 mf Cer 150 v	
C33	283-084	270 mf Cer 1000 v	5%
C102	283-003	0.01 mf Cer 150 v	
C105	290-189	33 mf EMT 35 v	10%
C126	281-546	330 pf Cer 500 v	10%
C131	283-000	0.001 mf Cer 500 v	
C135	Use 281-543	270 pf Cer 500 v	10%
C136	283-057	0.1 mf Cer 200v	
C137	283-000	0.001 mf Cer 500 v	
C143	283-032	470 pf Cer 500 v	5%
C150	281-523	100 pf Cer 350 v	
C151	283-000	0.001 mf Cer 500 v	
C159	283-003	0.01 mf Cer 150 v	
C160A	281-010	4.5-25 pf Cer Var	
C160B	281-508	12 pf Cer 500 v	
C160C	281-010	455 pf Cer Var	
C160D	281-574	82 pf Cer 500 v	10%
C160E	*295-808	0.001 mf Timing Series	
C160F		0.01 mf	
C160G		0.1 mf	
C160H		1 pf	
C160J	281-523	100 pf Cer 350 v	
C164	283-000	0.001 mf Cer 500 v	
C167	281-524	150 pf Cer 500 v	
C173	281-524	150 pf Cer 500 v	
C175A	281-530	100 pf Cer 500 v	10%

† Furnished as a unit with SW135.

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Capacitors *(Cont'd)*

Ckt. No.		Tektronix Part No.	Description			S/N Range
C1758		283-000	0.001 mf	Cer	500 v	
C175C	Use	285-695	0.01 mf	PTM	200 v	10%
C17SD		285-572	0.1 mf	PTM	200 v	
C175E		285-576	1 mf	PTM	100 v	10%
C175F		281-519	47 pf	Cer	500 v	10%
C181		281-523	100 pf	Cer	350 v	
C193		283-079	0.01 mf	Cer	250v	
C206		283-000	0.001 mf	Cer	500 v	
C215		283-003	0.01 mf	Cer	150 v	
C221		283-000	0.001 mf	Cer	500 v	
C234		283-003	0.01 mf	Cer	150 v	
C401		281-626	3.3 pf	Cer	200 v	5%
C411		283-000	0.001 mf	Cer	500 v	
C414		283-010	0.05 mf	Cer	50 v	X130-up
C435		290-134	22 mf	EMT	15 v	
C451		281-518	47 pf	Cer	500 v	X130-up
C458		283-002	0.01 mf	Cer	500 v	
C461		283-079	0.01 mf	Cer	250 v	
C464		283-000	0.001 mf	Cer	500 v	
C465		283-000	0.001 mf	Cer	500 v	
C466		283-026	0.2 mf	Cer	25 v	
C467		283-026	0.2 mf	Cer	25 v	
C469		283-079	0.01 mf	Cer	250 v	

Diodes

D18	Use	*152-0185-00	Silicon Replaceable by 1N3605
D20	Use	*152-0185-00	Silicon Replaceable by 1N3605
D28	Use	*152-0185-00	Silicon Replaceable by 1N3605
D30		*152-125	Tunnel Selected TD 3A 4.7 MA
D31		152-139	Zener 1N751 0.4w, 5.1 v, 10%
D101	Use	*152-0185-00	Silicon Replaceable by 1N3605
D102	Use	*152-0185-00	Silicon Replaceable by 1N3605
D106		*152-075	Germanium Tek Spec 4.7 MA
D010	Use	*152-0185-00	Silicon Replaceable by 1N3605
D111	Use	*152-0185-00	Silicon Replaceable by 1N3605
D112	Use	*152-0185-00	Silicon Replaceable by 1N3605
D141	Use	*152-0185-00	Silicon Replaceable by 1N3605
D143		*152-125	Tunnel Selected TD 3A
D147	Use	*152-0185-00	Silicon Replaceable by 1N3605
D150	Use	*152-0185-00	Silicon Replaceable by 1N3605
D154		152-0185-00	Germanium X1040-up
D155	Use	*152-0249-00	Silicon Assembly
D160		*152-461	Silicon Tek Spec
D161		*152-061	Silicon Tek Spec
D164		152-091	Zener 1N982 0.4w, 75v, 10%
D165		*152-107	Silicon Replaceable by 1N647

Diodes *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description	S/N Range
D167	Use *152-0185-00	Silicon Replaceable by 1N3605	
D176	*152-061	Silicon Tek Spec	
D178	*152-061	Silicon Tek Spec	
D179	*152-061	Silicon Tek Spec	
D189	*152-061	Silicon Tek Spec	
D200	Use *152-0185-00	Silicon Replaceable by 1N3605	
D209	152-061	Silicon Tek Spec	
D234	Use *152-0185-00	Silicon Replaceable by 1N3605	
D411	Use *152-0185-00	Silicon Replaceable by 1N3605	
D413	Use *152-0185-00	Silicon Replaceable by 1N3605	
D414	152-172	Zener IN970A 0.4w, 24v, 10%	
D415	Use *152-0185-00	Silicon Replaceable by 1N3605	
D420	Use *152-0185-00	Silicon Replaceable by 1N3605	
D423	Use *152-0185-00	Silicon Replaceable by 1N3605	
D430	Use *152-0185-00	Silicon Replaceable by 1N3605	
D433	Use *152-0185-00	Silicon Replaceable by 1N3605	
D462	152-060	Zener 1N3027A 1 w, 20v, 10%	

Inductors

L24	*108-057	8.8 mh	X150-up
L32	*108-057	8.8 mh	
L139	*108-147	2.2 mh	
L206	276-528	Core, Ferramic Suppressor	

Transistors

Q24	Use 151-131	2N964	
Q34	*151-108	Replaceable by 2N2501	
Q105	*151-108	Replaceable by 2N2501	
Q114	*151-096	Selected from 2N1893	
Q115	*151-108	Replaceable by 2N2501	
Q125	*151-103	Replaceable by 2N2219	
Q135	*151-103	Replaceable by 2N2219	
Q144	*151-108	Replaceable by 2N2501	
Q154	151-107	2N967	
Q164	*151-087	Selected from 2N1131	
Q184	151-135	2N2635	
Q194	*151-103	Replaceable by 2N2219	
Q204	*151-103	Replaceable by 2N2219	
Q234	*151-096	Selected from 2N1893	
Q414	*151-133	Selected from 2N3251	
Q423	*151-134	Replaceable by 2N2905	
Q424	*151-103	Replaceable by 2N2219	
Q433	*151-134	Replaceable by 2N2905	
Q434	*151-103	Replaceable by 2N2219	

Resistors

Resistors are fixed, composition, ±10%, unless otherwise indicated.

Ckt. No.		Tektronix Part No.		Description			S/N Range
R1		315-915	9.1 meg	1/4 w		5%	
R3		301-105	1 meg	1/2 w		5%	
R7		301-105	1 meg	1/2 w		5%	
R8		315-104	100 k	1/4 w		5%	
R10		316-224	220 k	1/4 w			
R12		301-225	2.2 meg	1/2 w		5%	
R13		315-473	47k	1/4 w		5%	
R14		315-224	220 k	1/4 w		5%	
R16A, B		311-217	2 x 1 meg		Var	TRIGGERING LEVEL	
R18		316-101	100 Ω	1/4 w			
R19		316-470	47 Ω	1/4 w			
R20		316-101	100 Ω	1/4 w			
R22		303-223	22 k	1 w		5%	
R24	Use	315-561	560 Ω	1/4 w		5%	
R26		303-753	75 k	1 w		5%	
R28		303-563	56 k	1 w		5%	
R31		305-153	15 k	2 w		5%	
R32		315-750	75 Ω	1/4 w		5%	
R33		315-100	10 Ω	1/4 w		5%	
R34		302-563	56 k	1/2 w			
R36		303-563	56 k	1 w		5%	
R102		315-681	680 Ω	1/4 w		5%	
R103		315-102	1 k	1/4 w		5%	
R105		315-562	5.6 k	1/4 w		5%	
R106		316-471	470 Ω	1/4 w			
R107		316-101	100 Ω	1/4 w			
R108		315-471	470 Ω	1/4 w		5%	
R110		315-124	120 k	1/4 w		5%	
R111		316-222	2.2 k	1/4 w			
R113		316-274	270 k	1/4 w			
R115		301-563	56 k	1/2 w		5%	
R116		301-563	56 k	1/2 w		5%	
R118		315-124	120 k	1/4 w		5%	
R119		316-474	470 k	1/4 w			
R120		302-155	1.5 meg	1/2 w			X130-up
R121		316-154	150 k	1/4 w			
R123		315-621	620 Ω	1/4 w		5%	
R124		315-184	180 k	1/4 w		5%	
R126		315-512	5.1 k	1/4 w		5%	
R127		315-134	130 k	1/4 w		5%	
R130		315-202	2 k	1/4 w		5%	
R131		315-202	2 k	1/4 w		5%	
R133		315-821	820 Ω	1/4 w		5%	
R135		316-473	47 k	1/4 w			
R137		316-473	47 k	1/4 w			
R139		316-331	330 Ω	1/4 w			

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Resistors

Resistors are fixed, composition, ±10%, unless otherwise indicated.

Ckt. No.		Tektronix Part No.		Description			S/N Range
R1		315-915	9.1 meg	1/4 w		5%	
R3		301-105	1 meg	1/2 w		5%	
R7		301-105	1 meg	1/2 w		5%	
R8		315-104	100 k	1/4 w		5%	
R10		316-224	220 k	1/4 w			
R12		301-225	2.2 meg	1/2 w		5%	
R13		315-473	47k	1/4 w		5%	
R14		315-224	220 k	1/4 w		5%	
R16A, B		311-217	2 x 1 meg		Var	TRIGGERING LEVEL	
R18		316-101	100 Ω	1/4 w			
R19		316-470	47 Ω	1/4 w			
R20		316-101	100 Ω	1/4 w			
R22		303-223	22 k	1 w		5%	
R24	Use	315-561	560 Ω	1/4 w		5%	
R26		303-753	75 k	1 w		5%	
R28		303-563	56 k	1 w		5%	
R31		305-153	15 k	2 w		5%	
R32		315-750	75 Ω	1/4 w		5%	
R33		315-100	10 Ω	1/4 w		5%	
R34		302-563	56 k	1/2 w			
R36		303-563	56 k	1 w		5%	
R102		315-681	680 Ω	1/4 w		5%	
R103		315-102	1 k	1/4 w		5%	
R105		315-562	5.6 k	1/4 w		5%	
R106		316-471	470 Ω	1/4 w			
R107		316-101	100 Ω	1/4 w			
R108		315-471	470 Ω	1/4 w		5%	
R110		315-124	120 k	1/4 w		5%	
R111		316-222	2.2 k	1/4 w			
R113		316-274	270 k	1/4 w			
R115		301-563	56 k	1/2 w		5%	
R116		301-563	56 k	1/2 w		5%	
R118		315-124	120 k	1/4 w		5%	
R119		316-474	470 k	1/4 w			
R120		302-155	1.5 meg	1/2 w			X130-up
R121		316-154	150 k	1/4 w			
R123		315-621	620 Ω	1/4 w		5%	
R124		315-184	180 k	1/4 w		5%	
R126		315-512	5.1 k	1/4 w		5%	
R127		315-134	130 k	1/4 w		5%	
R130		315-202	2 k	1/4 w		5%	
R131		315-202	2 k	1/4 w		5%	
R133		315-821	820 Ω	1/4 w		5%	
R135		316-473	47 k	1/4 w			
R137		316-473	47 k	1/4 w			
R139		316-331	330 Ω	1/4 w			

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Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description			S/N Range
R184	302-823	82 k 1/2 w			
R186	316-101	100 Ω 1/4 w			
R189	308-108	15 k 5 w		WW	5%
R190	304-223	22 k 1 w			
R192	315-331	330 Ω 1/4 w			5%
R193	315-121	120 Ω 1/4 w			5%
R195	315-202	2 k 1/4 w			5%
R197	315-822	8.2 k 1/4 w			5%
R198	315-432	4.3 k 1/4 w			5%
R200	315-132	1.3 k 1/4w			5%
R201	316-472	4.7 k 1/4 w			
R203	315-102	1 k 1/4 w			5%
R205	315-102	1 k 1/4 w			5%
R206	315-302	3 k 1/4 w			5%
R208	315-302	3 k 1/4 w			5%
R209	316-331	330 Ω 1/4 w			
R215	316-101	100 Ω 1/4 w			
R221	316-224	220 k			
R222	316-105	1 meg 1/4 w			
R223	316-101	100 Ω 1/4 w			
R225	303-223	22 k 1 w			5%
R226	316-103	10k 1/4 w			
R228	311-067	5 k 0.2 w	Var		EXT HORIZ GAIN
R229A†	311-481	30:k	Var		VARIABLE
R229B†		20k			
R233	315-222	2.2 k 1/4 w			5%
R235	301-433	43 k 1/4 w			5%
R236	305-153	15 k 2 w			5%
R237	303-243	24 k 1 w			5%
R239	315-472	4.7 k 1/4 w			5%
R340A	322-493	1 k 1/4 w		Prec	1%
R3408	321-161	464 Ω 1/8 w		Prec	1%
R340C	321-151	365 Ω 1/8 w		Prec	1%
R340D	321-119	160 Ω 1/8 w		Prec	1%
R340E	307-110	3 Ω 1/4w			5%
R340F	321-129	215 Ω 1/8 w		Prec	1%
R340J	307-103	2.7 Ω 1/4 w			5%
R340K	321-083	71.5 Ω 1/8 w		Prec	1%
R340L	323-044	28 Ω 1/2 w		Prec	1%
R340M	321-427	187 Ω 1/8 w		Prec	1%
R340P	309-449	4.6 Ω 1/2 w		Prec	1%
R401	323-335	30.1 k 1/2 w		Prec	1%
R402	311-315	20 k	Var		SWP CAL
R403	323-374	76.8 k 1/2 w		Prec	1%
R405	301-275	2.7 k 1/2 w			5%

† Furnished as a unit with SW229.

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description			S/N Range
R406†	311-478	1 meg		Var		POSITION
R408	323-368	66.5 k	1/2 w		Prec	1%
R409†	311-478	150 k		Var		POSITION
R411	323-385	100 k	1/2 w		Prec	1%
R413	321-285	9.09 k	1/8 w		Prec	1%
R415	316-274	270 k	1/4 w			
R416	305-103	10 k	2 w			5%
R421	308-319	4.5 k	3 w		WW	1%
R422	311-404	1 k		Var	WW	SWP MAG REGIS
R423	315-471	47 Ω	1/4 w			5%
R431	308-319	4.5 k	3 w		WW	1%
R433	315-471	470 Ω	1/4 w			5%
R434	316-270	27 Ω	1/4 w			
R435	316-101	100 Ω	1/4 w			
R437	316-101	100 Ω	1/4 w			
R439	308-111	6 k	8w		WW	5%
R442	316-101	100 Ω	1/4 w			
R444	308-111	6 k	8 w		WW	5%
R446	321-039	24.9 Ω	1/8 w		Prec	1%
R447	311-258	100 Ω		Var		X50 MAG GAIN
R448	321-039	24.9 Ω	8 w		Prec	1%
R449	315-331	330 Ω	1/4 w			5%
R451	316-101	100 Ω	1 w			X130-up
R455	302-151	150 Ω	1/2 w			
R456	302-151	150 Ω	1/2 w			
R458	307-103	2.7 Ω	4 w			5%
R459	308-107	1 k	5 w		WW	5%
R460	308-003	2 k	5 w		WW	5%
R461	307-103	2.7 Ω	1/4 w			5%
R462	305-822	82 k	2 w			5%
R464	301-910	91 Ω	1/2 w			5%
R467	316-220	22 Ω	1/4 w			
R469	307-103	2.7 Ω	1/4 w			5%

Switches

	Unwired	Wired		
SW5	260-615		Lever	SOURCE
SW8	260-594		Lever	COUPLING
SW10	260-472		Lever	SLOPE
SW130	260-623	*262-668	Rotary	TRIGGER MODE
SW135††	260-518		Push-Pull	PUSH TO RESET
				TIME/DIV OR
SW60	260-0624-01	*262-669	Rotary	HORIZONTAL VOLTS/DIV
SW229†††		311-481		CALIB

† R406 and R409 furnished as a unit.
†† Furnished as a unit with B118.
††† Furnished as a unit with R229A, B

Transformers

Ckt. No.	Tektronix Part No.	Description	S/N Range
T38	*120-278	Toroid, 3-8 Turn Winding	

Electron Tubes

V24	154-187	6DJ8	
V161	154-278	6BL8	
V173	154-187	6DJ8	
V444	154-340	7119	

SECTION 6

PREVENTIVE MAINTENANCE INSTRUCTIONS

6.1 SCOPE OF MAINTENANCE

The maintenance duties assigned to the operator and organizational repairman of this equipment are listed below with a reference to the paragraphs covering the specific maintenance functions. The preventive maintenance procedures require no special tools or test equipment.

(a) Daily preventive maintenance checks and services (paragraph 6.5).

(b) Weekly preventive maintenance checks and services (paragraph 6.6).

(c) Monthly preventive maintenance checks and services (paragraph 6.7).

(d) Quarterly preventive maintenance checks and services (paragraph 6.9).

(e) Cleaning (paragraph 6.11).

(f) Touchup painting instructions (paragraph 6.12).

6.2 MATERIALS REQUIRED FOR MAINTENANCE

(a) Trichoroethane (Federal stock No. 6810-292-9625).

WARNING

The fumes of trichloroethane are toxic. Provide thorough ventilation whenever used. DO NOT use near an open flame. Trichloroethane is not flammable, but exposure of the fume to an open flame converts the fumes to highly toxic, dangerous gases.

(b) Cleaning cloth.

(c) Fine sandpaper.

(d) Touchup paint.

6.3 PREVENTIVE MAINTENANCE

Preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble to reduce downtime and to assure that the equipment is serviceable.

(a) Systematic Care. The procedure given in paragraphs 6.3 through 6.12 covers routine systematic care and cleaning essential to proper upkeep and operation of the equipment.

(b) Preventive Maintenance Checks and Services. The maintenance checks and services charts outline functions to be performed at specific intervals. These checks and services are to maintain equipment in a combat serviceable condition; that is, in good general (physical) condition and in good operating condition. To assist operators in maintaining combat serviceability, the charts indicate what to check, how to check, and the normal conditions. The reference column lists the paragraphs that contain additional information. If the defect cannot be found by performing the corrective action indicated, higher category of maintenance or repair is required. Records and reports of these checks and services must be made in accordance with the requirements set forth in TM 38-750.

6.4 PREVENTIVE MAINTENANCE CHECKS AND SERVICES PERIODS

Preventive maintenance checks and services of this equipment ale required weekly, monthly, and quarterly. Daily maintenance checks and services are specified in paragraph 6.5. Paragraph 6.6 specifies checks and services that must be performed weekly. If the equipment is maintained in a standby condition, the daily and weekly checks should be accomplished at the same time. The maintenance checks and services that are accomplished monthly are specified in paragraph 6.7. Quarterly maintenance checks and services are specified in paragraph 6.9.

6.5 DAILY PREVENTIVE MAINTENANCE CHECKS AND SERVICES CHART

Sequence No.	Items to be inspected	Procedure	Reference
1	Completeness	See that the equipment is complete.	Appendix B
2	Cleanliness	Exterior of equipment must be clean and dry, free of fungus, dirt, dust or grease.	Paragraph 6.11
3	Operational Check	Check the operational efficiency.	
4	Controls	See that controls operate smoothly and are fastened in place securely.	

6.6 WEEKLY PREVENTIVE MAINTENANCE AND SERVICES CHART

Sequence No.	Items to be inspected	Procedure	Reference
1	Components	Inspect cards and cables for chafed, cracked, or frayed insulation. Replace connectors that are broken, stripped, or worn.	
2	Metal surfaces	Inspect exposed metal surface for rust and corrosion. Clean and touch up with paint as required.	Paragraphs 6.11 and 6.12

6.7 MONTHLY MAINTENANCE

Perform the maintenance functions indicted in the monthly preventive maintenance checks and services chart (paragraph 6.8) once each month. Periodic daily (paragraph 6.5) and weekly (paragraph 6.6) services constitute a part of the monthly checks.

6.8 MONTHLY PREVENTIVE MAINTENANCE CHECKS AND SERVICES CHART

Sequence No.	Items to be inspected	Procedure
1	Terminations	Inspect for loose connections and cracked or broken insulation.
2	Control panel	Clean panel thoroughly and check all surfaces for chips, cracks, or abnormal wear.
3	Hardware	Inspect all hardware for possible damage.

6.9 QUARTERLY MAINTENANCE

Quarterly preventive maintenance checks and services are required for this equipment. Periodic daily, weekly, and monthly services constitute a part of the quarterly preventive maintenance checks and services and must be performed concurrently. All deficiencies or shortcomings will be recorded in accordance with the requirements of TM 38-750. Perform all the checks and services listed in the quarterly preventive maintenance checks and services chart (paragraph 6.10) in the sequence listed. Adjustment of the maintenance interval must be made to compensate for any unusual operating conditions.

6.10 QUARTERLY PREVENTIVE MAINTENANCE CHECKS AND SERVICES CHART

Sequence No.	Items to be inspected	Procedure	Reference
1	Publications	See that all publications are complete, serviceable, and current.	DA Pam 310-4
2	Modifications	Check DA Pam 310-7 to determine whether new applicable MWO's have been published. All URGENT MWO's must be applied immediately. All NORMAL MWO's must be scheduled.	TM 38-750 and DA Pam 310-7

6.11 CLEANING

Inspect the exterior surfaces. The surfaces must be free of dust, dirt grease, and fungus.

(a) Remove dust and loose dirt with a clean, soft cloth.

(b) Remove grease, fungus, and ground-in dirt. Use a damp cloth (not wet) with trichloroethane to clean terminations. If dirt on the body of the unit is difficult to remove, use mild soap and water.

(c) Remove dust or dirt from the jacks and plugs with a brush.

6.12 TOUCHUP PAINTING INSTRUCTIONS

Remove dust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to applicable cleaning and refinishing practices specified in TB 746-10.

SECTION 7

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE

REPAIR PARTS AND SPECIAL TOOLS LIST

INTRODUCTION

1. Scope. This RPSTL lists and authorizes spares and repair parts required for performance of direct and general support maintenance of Time Base Plug-In, Tektronix Type 3B4. It authorizes the requisitioning, issue, and disposition of spares and repair parts as indicated by the Source, Maintenance and Recoverability (SMR) codes.

2. General. This Repair Parts and Special Tools List is divided as follows:

a. Repair Parts List. A list of spares and repair parts authorized by this RPSTL for use in the performance of maintenance. Parts lists are composed of functional groups in ascending numeric sequence. Parts are listed in alphabetical sequence within each figure number.

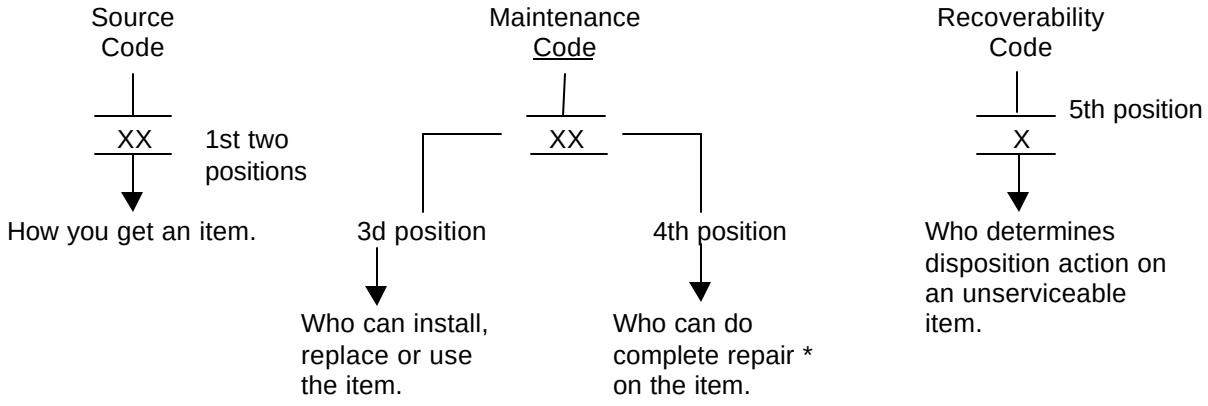
b. Special Tools List. Not applicable.

c. National Stock Number and Part Number Index. A list, in National Item Identification Number (NIIN) sequence, of all National Stock Numbered items (NSN) appearing in the listing, followed by a list in alphanumeric sequence of all part numbers appearing in the listing. NSN's and part numbers are cross-referenced to the figure and item number appearance.

3. Explanation of Columns (Repair Parts List)

a. Item No. (Column (1)). Indicates the number used to identify each item appearing in the listing.

b. SMR CODE (Column (2)). The Source, Maintenance, and Recoverability (SMR) code is a 5-position code containing supply/requisitioning information, maintenance category authorization criteria, and disposition instructions as shown in the following breakdown:



*Complete Repair: Maintenance capacity, capability, and authority to perform all the corrective maintenance tasks of the "Repair" function in a use/user environment in order to restore serviceability to a failed item.

(1) **Source Code.** The source code tells you how you get an item needed for maintenance, repair, or overhaul of an end item/equipment. Source codes are always the first two positions of the SMR code. Explanation of source codes follows:

Code	Explanation
PA -	Stocked items; use the applicable NSN to request/requisition items with this code. This item is authorized to the category indicated by the code entered in the 3d position of the SMR code.
XD -	Item is not stocked. Order an "XD" coded item through normal supply channels using the FSCM and part number given, if no NSN is available.

(2) **Maintenance Code.** Maintenance codes tell you the level(s) of maintenance authorized to USE and REPAIR support items. The maintenance codes are entered in the third and fourth positions of the SMR code as follows:

(a) The maintenance code entered in the third position tells you the lowest maintenance level authorized to remove, replace, and use an item. The maintenance code entered in the third position will indicate authorization to the following level of maintenance.

Code	Application/Explanation
F	-Direct support level can remove, replace, and use the item.

(b) The maintenance code entered in the fourth position tells you whether or not the item is to be repaired and identifies the lowest maintenance level with the capability to do complete repair (i.e., perform all authorized repair functions). This position will contain the following code.

Code	Application/Explanation
Z	-Nonreparable. No repair is authorized.

(3) **Recoverability Code.** Recoverability codes are assigned to items to indicate the disposition action on unserviceable items. The recoverability code is entered in the fifth position of the SMR code as follows:

Recoverability Codes	Definition
Z	-Nonreparable item. When unserviceable, condemn and dispose of the item at the level of maintenance shown in the third position of the SMR code.

c. FSCM (Column (3)). The Federal Supply Code for Manufacturer (FSCM) is a 5-digit numeric code which is used to identify the manufacturer, distributor, or Government agency, etc., that supplies the item.

d. PART NUMBER (Column (4)). Indicates the primary number used by the manufacturer (individual, company, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications standards, and inspection requirements to identify an item or range of items.

NOTE: When you use an NSN to requisition an item, the item you receive may have a different part number from the part ordered, but go ahead and use or furnish it as the replacement part.

e. DESCRIPTION AND USABLE ON CODE (UOC) (Column (5)). This column includes the following information:

(1) The Federal item name and, when required, a minimum description to identify the item.

(2) The usable on code, when applicable (see paragraph 5, Special Information).

f. QTY (Column (6)). The QTY (quantity per figure column) indicates the quantity of the item used in the parts list which is prepared for a functional group, subfunctional group, or an assembly.

4. Explanation of Columns

a. NATIONAL STOCK NUMBER (NSN) INDEX

(1) **STOCK NUMBER column.** This column lists the NSN by National Item Identification Number (NIIN) sequence. The NIIN consists of the last nine digits of the NSN (i.e., 5305-01-674-1467). When using this column to locate an item, ignore the first 4 digits of the NSN. However, the complete NSN should be used when ordering items by stock number.

(2) **FIG. column.** Indicates the figure number used to identify each item appearing in the listing. The figures are in numerical order in Section II.

(3) **ITEM column.** The item number identifies the item associated with the figure listed in the adjacent FIG. column. This item is also identified by the NSN listed on the same line.

b. PART NUMBER INDEX. Part numbers in this index are listed by part number in ascending alphanumeric sequence (i.e., vertical arrangement of letter and number combination which places the first letter or digit of each group in order A through Z, followed by the numbers 0 through 9 and each following letter or digit in like order).

(1) **FSCM column.** The Federal Supply Code for Manufacturer (FSCM) is a 5-digit numeric code used to identify the manufacturer, distributor, or Government agency, etc., that supplies the item.

(2) **PART NUMBER column.** Indicates the primary number used by the manufacturer (individual, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications standards, and inspection requirements to identify an item or range of items.

(3) **STOCK NUMBER column.** This column lists the NSN for the associated part number and manufacturer identified in the PART NUMBER and FSCM columns to the left. The part number line entry (with NSN, when available) identifies the first figure/item number appearance for which the part number is applicable. The part number is not listed for additional figure/item number appearances identified by that part number.

(4) **FIG. column.** This column lists the number of the figure where the item is located in Section II.

(5) **ITEM column.** The item number is that number assigned to the item as it appears in the figure referenced in the adjacent figure number column.

5. Special Information

a. Repair parts for components of standards sets which can be identified as existing in the supply system will be requisitioned through normal supply channels from the appropriate supply commodity manager.

b. Repair parts for components of standards sets which cannot be identified as to proper supply source will be requisitioned from USAMICOM, using routing identifier B64 and furnishing, as a minimum, the following as exception data.

(1) Component stock number of the individual end item to be repaired.

(2) Component manufacturer's equipment model number and serial number.

(3) The equipment manufacturer's stock number as listed in the appropriate manual for the desired repair part.

(4) The repair part reference designation, circuit reference, circuit symbol schematic designation, or reference number as listed in the manufacturer's manual.

(5) The technical specification of the repair part as contained in the appropriate manufacturer's manual.

(6) The title and date of the manufacturer's manual from which the information in **a** and **b** (3), (4), and (5) above was taken.

c. For requisitioning miscellaneous consumable maintenance supplies or expendable supplies, use CTA 50-970.

d. The usable on code appears in the lower left corner of the Description column heading. Usable on codes are shown as "UOC" in the Description column (justified left) on the first line applicable item description/nomenclature.

e. This RPSTL does not contain illustration for items listed in the Repair Parts List, since the manufacturer's manuals contain exploded view illustrations which are adequate for repair parts location. Copies of the manufacturer's manual (Tektronix Type 3B4) are furnished with the equipment for which this RPSTL is prepared. The figure and item numbers in the listing are for locating the item within this RPSTL.

6. How to Locate Repair Parts

a. When National Stock Number or Part Number is Not Known.

(1) **First.** Refer to the parts list to locate the item by description. This list is listed in alphabetical sequence within each figure number.

(2) **Second.** After locating the item in the Repair Parts List, refer to the Part Number Index to find the NSN.

b. When National Stock Number or Part Number is Known.

(1) **First.** Using the Index of National Stock Numbers and Part Numbers, find the pertinent National Stock Number or Part Number. The NSN index is in National Item Identification Number (NIIN) sequence. The part numbers in the Part Number index are listed in ascending alphanumeric sequence. Both indexes cross-reference you to the illustration figure and item number of the item you are looking for.

(2) **Second.** After finding the figure and item number, verify that the item is the one you're looking for, then locate the item number in the repair parts list for the figure.

7. Abbreviations. Not applicable.

(1) ITEM NO	(2) SMR CODE	(3) FSCM	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
				GROUP 0010 - FIGURE 1 PLUG-IN, TIME BASE 3B4MOD (80009) 7912040-2 (19200)	
10	PAFZZ	56289	44C56A4	CAPACITOR, FIXED 250 V DC, .01 UF	3
20	PAFZZ	18876	9995445	CAPACITOR, FIXED 500 V DC, 47 UUF (+- 10 0/0)	1
30	PAFZZ	56289	29C189A	CAPACITOR, FIXED 50 V DC, .05 UF 283-0010-00 80009*	1
35	PAFZZ	72982	301-024X5P1271K	CAPACITOR, FIXED	1
40	PAFZZ	56289	41C208	CAPACITOR, FIXED 200 V DC, 100,000 UUF (+ 80 - 20 0/0)	1
50	PAFZZ	72982	NP0331-12P0RMSPC	CAPACITOR, FIXED 500 V DC, 12 UUF, TYPE NP0331-12P0RMPCT	1
60	PAFZZ	81349	CC22UJ470G	CAPACITOR, FIXED 500 V DC, 47 UUF (+- 2 0/0)	1
70	PAFZZ	80009	281-0574-00	CAPACITOR, FIXED 500 V DC, 82 UUF (+- 10 0/0)	1
80	PAFZZ	81349	CC30UJ101G	CAPACITOR, FIXED 500 V DC, 100 UUF, TYPE CC30UJ101G	1
90	PAFZZ	81349	CK22AX151K	CAPACITOR, FIXED 500 V DC, 150 UUF, TYPE CK22AX151K (+- 10 0/0)	2
100	PAFZZ	81349	CK2ZAX331K	CAPACITOR, FIXED 500 V DC, 330 UUF, TYPE CK22AX331K	1
110	PAFZZ	18876	10156805-1	CAPACITOR, FIXED 500 V DC, 1,000 UUF	1
120	PAFZZ	80009	281-0538-00	CAPACITOR, FIXED 500 V DC, 1 UF	1
130	PAFZZ	80183	33C35A	CAPACITOR, FIXED	1
140	PAFZZ	81349	M39003/01-3029	CAPACITOR, FIXED 1 SEC, 35 V DC, 33 UF, TYPE CSR13F336KL	1
150	PAFZZ	81349	CTM104VCJ	CAPACITOR, FIXED 400 V DC, 100,000 UUF (+- 5 0/0)	1
160	PAFZZ	56289	19C429	CAPACITOR, FIXED, CER 1,000 V DC, 270 UUF (+- 5 0/0)	1
170	PAFZZ	60705	20C89A3	CAPACITOR, FIXED, CER	7
180	PAFZZ	56289	5C023224X025C83	CAPACITOR. FIXED, CER 25 V DC, 220,000 UUF (+- 20 0/0)	2
190	PAFZZ	81349	CK63AW103M	CAPACITOR. FIXED, CER 500 V DC, 10,000 UUF, TYPE CK63AW103M3	1
200	PAFZZ	81349	M39003/01-2991	CAPACITOR, FIXED, ELE 1 SEC, 15 V DC, 22 UF (+- 10 0/0)	1
210	PAFZZ	18876	10193242-003	CAPACITOR, VARIABLE 500 V DC, 4.5 UUF	2
220	PAFZZ	80009	108-0057-00	COIL 8.8 UH	2
230	PAFZZ	80009	108-147	COIL, RADIO 2.2 UH	1
240	PAFZZ	81349	M39012/21-0002	CONNECTOR 1 FEMALE CONTACT, STGHT SHAPE, 0.557 W, 0.312 LG	3
250	PAFZZ	02114	55-590-65-3B	CORE, ELECTROMAGNET	1
260	PAFZZ	73445	7119	ELECTRON TUBE	1
270	PAFZZ	08806	5A8-T	LAMP, GLOW 1/25 W, 60 V AC, 70 V DC, T-2 BULB, NO. NE-23	3
280	PAFZZ	81349	RCR07G2R7JS	RESISTOR, FIXED 1/4 W, 2.7 OHMS, TYPE	4

(1) ITEM NO	(2) SMR CODE	(3) FSCM	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
				RCR07G2R7JS (+- 5 0/C)	
290	PAFZZ	81349	RCR07G3R0JS	RESISTOR, FIXED 1/4 W, 3 OHMS, TYPE RCR07G3R0JS (+- 5 0/C)	1
300	PAFZZ	81349	RCR07G100JS	RESISTOR, FIXED 1/4 W, 10 OHMS, TYPE RCR07G100JS (+- 5 0/C)	1
310	PAFZZ	81349	RCR07G220JS	RESISTOR, FIXED 1/4 W, 22 OHMS, TYPE RCR07G220JS (+- 5 0/C)	1
320	PAFZZ	81349	RCR07G270JS	RESISTOR, FIXED 1/4 W, 27 OHMS, TYPE RCR07G270JS (+- 5 0/C)	1
330	PAFZZ	81349	RCR07G470JS	RESISTOR, FIXED 1/4 W, 47 OHMS, TYPE RCR07G470JS (+- 5 0/C)	1
340	PAFZZ	81349	RCR07G750JS	RESISTOR, FIXED 1/4 W, 75 OHMS, TYPE RCR07G750JS (+- 5 0/C)	1
350	PAFZZ	81349	RCR07G820JS	RESISTOR, FIXED 1/4 W, 82 OHMS, TYPE RCR07G820JS (+- 5 0/C)	1
360	PAFZZ	81349	RCR07G010IJS	RESISTOR, FIXED 1/4 W, 100 OHMS, TYPE RCR07G101JS (+- 5 0/C)	13
370	PAFZZ	81349	RCR07G121JS	RESISTOR, FIXED 1/4 W, 120 OHMS, TYPE RCR07G121JS {+- 5 0/C)	1
380	PAFZZ	81349	RCR07G331JS	RESISTOR, FIXED 1/4 W, 330 OHMS, TYPE RCR07G331JS (+- 5 0/C)	2
390	PAFZZ	81349	RCR07G471JS	RESISTOR, FIXED 1/4 W, 470 OHMS, TYPE RCR07G471JS (+- 5 0/C)	5
400	PAFZZ	81349	RCR07G561JS	RESISTOR, FIXED 1/4 W, 560 OHMS, TYPE RCR07G561JS (+- 5 0/C)	1
410	PAFZZ	81349	RCR07G621JS	RESISTOR, FIXED 1/4 W, 620 OHMS, TYPE RCR07G621JS (+- 5 0/C)	1
420	PAFZZ	81349	RCR07G681JS	RESISTOR, FIXED 1/4 W, 680 OHMS, TYPE RCR07G681JS (+- 5 0/C)	1
430	PAFZZ	81349	RCR07G821JS	RESISTOR, FIXED 1/4 W, 820 OHMS, TYPE RCR07TG821JS (+- 5 0/C)	1
440	PAFZZ	81349	RCR07G102JS	RESISTOR, FIXED 1/4 W, 1,000 OHMS, TYPE RCR07G102JS (+- 5 0/0)	8
450	PAFZZ	81349	RCR07G132JS	RESISTOR, FIXED 1/4 W, 1.300 OHMS, TYPE RCR07G132JS (+- 5 0/0)	1
460	PAFZZ	81349	RCR07G202JS	RESISTOR, FIXED 1/4 W, 2,000 OHMS, TYPE RCR07G202JS (+- 5 0/0)	3
470	PAFZZ	81349	RCR07G222JS	RESISTOR, FIXED 1/4 W, 2,200 OHMS, TYPE RCR07G222JS (+- 5 0/0)	2
480	PAFZZ	81349	RCR07G302JS	RESISTOR, FIXED 1/4 W, 3,000 OHMS, TYPE RCR07G302JS (+- 5 0/0)	2
500	PAFZZ	81349	RCR07G432JS	RESISTOR, FIXED 1/4 W, 4,300 OHMS, TYPE RCR07G432JS (+- 5 0/0)	1
510	PAFZZ	81349	RCR07G472JS	RESISTOR, FIXED 1/4 W, 1,4700 OHMS, TYPE RCR07G472JS (+- 5 0/0)	2
520	PAFZZ	81349	RCR07G512JS	RESISTOR, FIXED 1/4 W, 5,100 OHMS, TYPE RCR07G512JS (+- 5 0/0)	1
530	PAFZZ	81349	RCR07G562JS	RESISTOR, FIXED 1/4 W, 5,600 OHMS, TYPE RCR07G562JS (+- 5 0/0)	1
540	PAFZZ	81349	RCR07G622JS	RESISTOR, FIXED 1/4 W, 6,200 OHMS, TYPE RCR07G622JS (+- 5 0/0)	1
550	PAFZZ	81349	RCR07G822JS	RESISTOR, FIXED 1/4 W, 8,200 OHMS,	1

(1) ITEM NO	(2) SMR CODE	(3) FSCM	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
				TYPE RCR07G822JS (+- 5 0/0)	
560	PAFZZ	81349	RCR07G103JS	RESISTOR, FIXED 1/4 W, 10,000 OHMS, TYPE RCR07G103JS (+- 5 0/0)	2
570	XDFZZ	81349	RC07GF113J	RESISTOR, FIXED 1/4 W, 11,000 OHMS, TYPE RC07GF113J (+- 5 0/0)	1
580	PAFZZ	81349	RCR07G123JS	RESISTOR, FIXED 1/4 W,12,000 OHMS, TYPE RCR07G123JS (+- 5 0/0)	1
590	PAFZZ	81349	RCR07G333JS	RESISTOR, FIXED 1/4 W, 33,000 OHMS, TYPE RCR07G333JS (+- 5 0/0)	1
600	PAFZZ	81349	RCR07G473JS	RESISTOR, FIXED 1/4 W, 47,000 OHMS, TYPE RCR07G473JS (+- 5 0/0)	1
610	PAFZZ	81349	RCR07G104JS	RESISTOR, FIXED 1/4 W, 100,000 OHMS, TYPE RCR07G104JS (+- 5 0/0}	2
620	PAFZZ	81349	RCR07G124JS	RESISTOR, FIXED 1/4 W, 120,000 OHMS, TYPE RCR07G124JS (+- 5 0/0)	3
640	PAFZZ	81349	RCR07G134JS	RESISTOR, FIXED 1/4 W, 130,000 OHMS, TYPE RCR07G134JS (+- 5 0/0)	1
650	PAFZZ	81349	RCR076154JS	RESISTOR, FIXED 1/4 W, 150,000 OHMS, TYPE RCR07G154JS (+- 5 0/0)	2
660	PAFZZ	81349	RCR07G184JS	RESISTOR, FIXED 1/4 W, 180,000 OHMS, TYPE RCR07G184JS (+- 5 0/0)	1
670	PAFZZ	81349	RCR07G224JS	RESISTOR, FIXED 1/4 W, 220,000 OHMS, TYPE RCR07G224JS (+- 5 0/0)	3
680	PAFZZ	81349	RCR07G274JS	RESISTOR, FIXED 1/4 W, 270,000 OHMS, TYPE RCR07G274JS (+- 5 0/0)	2
690	PAFZZ	81349	RCR07G334JS	RESISTOR, FIXED 1/4 W, 330,000 OHMS, TYPE RCR07G334JS (+- 5 0/0)	1
700	PAFZZ	81349	RCR07G474JS	RESISTOR, FIXED 1/4 W, 470,000 OHMS, TYPE RCR07G474JS (+- 10 0/0)	1
710	PAFZZ	81349	RCR07G105JS	RESISTOR, FIXED 1/4 W, 1 MEG, TYPE RCR07G105JS (+- 5 0/0)	1
720	PAFZZ	81349	RCR07G225JS	RESISTOR, FIXED 1/4 W, 2.2 MEG, TYPE RCR07G225JS (+- 5 0/C)	1
730	PAFZZ	81349	RCR07G335JS	RESISTOR, FIXED 1/4 W, 3.3 MEG, TYPE RCR07G335JS (+- 5 0/0)	1
740	PAFZZ	81349	RCR20G910JS	RESISTOR, FIXED 1/2 W, 91 OHMS, TYPE RCR20G910JS (+- 5 0/0)	1
750	PAFZZ	81349	RCR20G151JS	RESISTOR, FIXED 1/2 W, 150 OHMS, TYPE RCR20G151JS (+- 5 0/0)	2
760	PAFZZ	81349	RCR20G302JS	RESISTOR, FIXED 1/2 W, 3,000 OHMS, TYPE RCR20302JS (+- 5 0/0)	1
770	PAFZZ	81349	RCR20G472JS	RESISTOR, FIXED 1/2 W, 4,700 OHMS, TYPE RCR206472JS (+- 5 0/0)	1
780	PAFZZ	81349	RCR20G103JS	RESISTOR, FIXED 1/2 W, 10,000 OHMS, TYPE RCR20G103JS (+- 5 0/0)	1
790	PAFZZ	81349	RCR20G433JS	RESISTOR, FIXED P0RM 5 PCT	1
800	PAFZZ	81349	RCR20G563JS	RESISTOR, FIXED 1/2 W, 56,000 OHMS, TYPE RCR20G563JS (+- 5 0/0)	2
810	PAFZZ	81349	RCR20G823JS	RESISTOR, FIXED 1/2 W, 82,000 OHMS,	1

(1) ITEM NO	(2) SMR CODE	(3) FSCM	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
				TYPE RCR20G823JS (+- 5 0/0)	
820	PAFZZ	81349	RCR20G134JS	RESISTOR, FIXED 1/2 W, 130,000 OHMS, TYPE RCR20G134JS (+- 5 0/0)	1
830	PAFZZ	81349	RCR20G105JS	RESISTOR, FIXED 1/2 W, 1 MEG, TYPE RCR20G105JS (+- 5 0/0)	2
840	PAFZZ	81349	RCR20G155JS	RESISTOR, FIXED 1/2 W, 1.5 MEG, TYPE RCR20G155JS (+- 5 0/0)	1
850	PAFZZ	81349	RCR07G915JS	RESISTOR, FIXED 1/4 W, 9.1 MEG (+- 5 0/0)	1
860	PAFZZ	81349	RCR20G225JS	RESISTOR, FIXED 1/2 W, 2.2 MEG, TYPE RCR20G225JS (+- 5 0/0)	1
870	PAFZZ	81349	RCR20G275JS	RESISTOR, FIXED 1/2 W, 2.7 MEG, TYPE RCR20G275JS (+ - 5 0/0)	1
880	PAFZZ	81349	RCR32G223JS	RESISTOR, FIXED 1 W, 22,000 OHMS, TYPE RCR32G223JS	4
890	PAFZZ	81349	RCR32G243JS	RESISTOR, FIXED	1
900	PAFZZ	81349	RCR32G563JS	RESISTOR, FIXED 1 W, 56,000 OHMS, TYPE RCR32G563JS (+- 5 0/0)	2
910	PAFZZ	81349	RCR32G753JS	RESISTOR, FIXED 1 W, 75,000 OHMS, TYPE RCR32G753JS (+- 5 0/0)	1
920	PAFZZ	81349	RCR42G103JR	RESISTOR, FIXED 2 W, 10,000 OHMS, TYPE RCR42GF103J (+- 5 0/0)	2
930	PAFZZ	81349	RCR42G273JS	RESISTOR, FIXED 2 W, 27,000 OHMS, TYPE RC42GF273J (+- 5 0/0)	1
940	PAFZZ	81349	RCR42G151JS	RESISTOR, FIXED, COMP 2 W, 150 OHMS, TYPE RC42GF151J (+- 5 0/0)	1
950	PAFZZ	81349	RCR42G153JS	RESISTOR, FIXED, COMP 2 W, 15,000 OHMS, TYPE RC42GF153J (+- 5 0/0)	1
960	PAFZZ	81349	RNR60C18R7FS	RESISTOR, FIXED, FILM 1/8 W, 18.7 OHMS (+- 1 0/0)	1
970	PAFZZ	81349	RNR70C1003FS	RESISTOR, FIXED, FILM 1/2 W (±1%).	2
980	PAFZZ	81349	RNR60C71R5FS	RESISTOR, FIXED, FILM 1/8 W, 71.5 OHMS, TYPE RNR60C71R5FS (+- 1 0/0)	1
990	XDFZZ	81349	RNC70H4993BS	RESISTOR, FIXED, FILM 1/2 W, 499,000 OHMS (+- 1 0/0)	1
1000	XDFZZ	81349	RNR60K1600DM	RESISTOR, FIXED, FILM 1/8 W, 160 OHMS, TYPE RNR60K1600DM (+- 0.5 0/0)	1
1010	PAFZZ	81349	RNC60K2150FS	RESISTOR, FIXED, FILM 1/8 W, 215 OHMS, (+- 1 0/0)	1
1020	PAFZZ	81349	RNR60C2490FS	RESISTOR, FIXED, FILM 1/8 W, 249 OHMS, TYPE RNR60C2490FS (+- 1 0/0)	2
1030	PAFZZ	81349	RNR60C3650FS	RESISTOR, FIXED, FILM 1/8 W, 365 OHMS, TYPE RNR60C3650FS (+- 1 0/0)	1
1040	PAFZZ	81349	RNR60C4640FS	RESISTOR, FIXED, FILM 1/8 W, 464 OHMS, TYPE RNR60C4640FS (+- 1 0/0)	1
1050	PAFZZ	81349	RNR60C9091FS	RESISTOR, FIXED, FILM 1/8 W, 9,090 OHMS, TYPE RNR60C9091FS (+- 1 0/0)	1
1060	PAFZZ	81349	RNR65C1001FS	RESISTOR, FIXED, FILM 1/4 W, 1,000 OHMS, TYPE RNR65C1001FM (+- 1 0/0)	1
1070	XDFZZ	81349	RN70D28R0F	RESISTOR, FIXED, FILM 1/2 W, 28 OHMS, (+- 1 0/0)	1
1080	PAFZZ	81349	RNC70K1652FS	RESISTOR, FIXED, FILM 1/2 W, 16,500	2

(1) ITEM NO	(2) SMR CODE	(3) FSCM	(4) PART NUMBER	(5) DESCRIPTION AND USABLE ON CODES (UOC)	(6) QTY
				OHMS, TYPE RNR70K1652FM (+- 1 0/0)	
1090	PAFZZ	81349	RNC70K7682FS	RESISTOR, FIXED, FILM 1/2 W, 76,800 OHMS, TYPE RNR70K7682FM	1
1100	XDFZZ	81349	RNR70K6652FM	RESISTOR, FIXED, FILM 1/2 W, 66,500 OHMS, TYPE RNR70K6652FM	1
1120	PAFZZ	81349	RNC70K1003FS	RESISTOR, FIXED, FILM 1/2 W, 100,000 OHMS, TYPE RNR70K1003FM (+- 1 0/0)	2
1130	PAFZZ	81349	RNR70C1503FS	RESISTOR, FIXED, FILM 1/2 W, 150,000 OHMS, TYPE RNR70C1503FM (+- 5 0/0)	1
1140	PAFZZ	81349	RNC70K1503FS	RESISTOR, FIXED, FILM 1/2 W, 150,000 OHMS, TYPE RNR70K1503FM (+- 1 0/0)	1
1150	XDFZZ	81349	RNC70H2493BS	RESISTOR, FIXED, FILM 1/2 W, 249,000 OHMS, TYPE RN70C2493B (+- 0.10 0/0)	1
1160	PAFZZ	81349	RNR70C7503FS	RESISTOR, FIXED, FILM 1/2 W, 750,000 OHMS, TYPE RNR70C7503FS (+- 1 0/0)	2
1170	XDFZZ	18876	9995632-3	RESISTOR, FIXED, FILM 1/2 W ,1.5 MEG (+- 1 0/0)	1
1180	PAFZZ	81349	RNC70K4872FS	RESISTOR, FIXED, FILM	1
1190	XDFZZ	63743	K46604	RESISTOR, FIXED, WIRE 8 W, 6,000 OHMS (+- 5 0/0)	2
1200	PAFZZ	80009	308-0002-00	RESISTOR, FIXED, WIRE 5 W, 2,000 OHMS (+- 5 0/0)	1
1210	PAFZZ	81349	RW67V102	RESISTOR, FIXED, WIRE 6.5 W, 1,000 OHMS, TYPE RW67V102 (+- 5 0/0)	1
1220	PAFZZ	11237	4962	RESISTOR, VARIABLE 100 OHMS	1
1230	PAFZZ	59873	152-0061-00	SEMICONDUCTOR DEVIC	7
1240	PAFZZ	15818	CD6538	SEMICONDUCTOR DEVIC	23
1250	PAFZZ	03877	T12G	SEMICONDUCTOR DEVIC	1
1260	PAFZZ	03508	STD704	SEMICONDUCTOR DEVIC	2
1270	PAFZZ	81349	JAN1N751A	SEMICONDUCTOR DEVIC TYPE JAN1N751A	1
1280	PAFZZ	81349	JAN1N647	SEMICONDUCTOR DEVIC TYPE 1N647	1
1290	PAFZZ	81349	JAN1N3027B	SEMICONDUCTOR DEVIC TYPE 1N3027B	1
1300	PAFZZ	81349	JAN1N970B	SEMICONDUCTOR DEVIC TYPE JAN1N970B	1
1310	PAFZZ	81349	JAN1N982B	SEMICONDUCTOR DEVIC TYPE 1N982B	1
1320	PAFZZ	72619	M32-1151-1631	SWITCH, PUSH	1
1330	PAFZZ	80009	120-0278-00	TRANSFORMER, RADIO	1
1340	PAFZZ	01295	2N967	TRANSISTOR	1
1350	PAFZZ	80009	151-0108-00	TRANSISTOR	4
1360	PAFZZ	81349	JAN2N3251A	TRANSISTOR	1
1370	PAFZZ	81349	JAN2N1131	TRANSISTOR TYPE JAN2N1131	1
1380	PAFZZ	81349	JAN2N964	TRANSISTOR GERMANIUM, HERMETICALLY SEALED, 0.23 DIA, 0.21 LG, W/3 WIRE LEAD TYPE TERM	1
1390	PAFZZ	81349	JAN2N2905A	TRANSISTOR SILICON, HERMETICALLY SEALED, 0.26 X 0.37, W/3 WIRE LEAD TYPE TERM	2
1400	PAFZZ	81349	JAN2N2219A	TRANSISTOR SILICON, HERMETICALLY SEALED, 0.37 X 0.26, W/3 WIRE LEAD TYPE TERM., TYPE 2N2219	6
1410	PAFZZ	81349	JAN2N1893	TRANSISTOR SILICON, HERMETICALLY SEALED, 0.375 DIA, 0.26 LG, W/3 WIRE LEAD TYPE TERM	2

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5950-00-815-7309	1	230			
5961-00-821-2309	1	1270			
5910-00-822-5683	1	190			
5910-00-823-1916	1	100			
5910-00-828-1455	1	120			
5910-00-828-5705	1	130			
5910-00-835-2642	1	150			
5961-00-849-4186	1	1290			
5961-00-853-2601	1	1410			
5935-00-853-7596	1	240			
5930-00-856-9116	1	1320			
5961-00-878-4287	1	1300			
5905-00-879-3635	1	1210			
5910-00-879- 5921	1	30			
5950-00-896-7453	1	220			
5905-00-898-1825	1	1200			
5961-00-900-6703	1	1340			
5961-00-905-6871	1	1230			
5905-00-910-0763	1	1220			
5961-00-911-6015	1	1360			
5950-00-913-5595	1	1330			
5910-00-916-3648	1	110			
5910-00-919-4374	1	160			
5961-00-923-9772	1	1260			
5910-00-935-3401	1	90			
5961-00-936-7604	1	1240			
5910-00-948-8934	1	35			
5961-00-949-1432	1	1400			
5961-00-949-1440	1	1390			
5910-00-978-9113	1	70			
5961-00-985-4900	1	1280			
5905-01-018-4274	1	1090			
5905-01-173-7557	1	960			

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81349	CC22UJ470G	5910-00-807-1543	1	60
81349	CC30UJ101G	5910-00-615-0105	1	80
15818	CD6538	5961-00-936-7604	1	1240
81349	CK22AX151K	5910-00-935-3401	1	90
81349	CK22AX331K	5910-00-823-1916	1	100
81349	CK63AW103M	5910-00-822-5683	1	190
81349	CTM104VCJ	5910-00-835-2642	1	150
81349	JAN1N3027B	5961-00-849-4186	1	1290
81349	JAN1N647	5961-00-985-4900	1	1280
81349	JAN1N751A	5961-00-821-2309	1	1270
81349	JAN1N970B	5961-00-878-4287	1	1300
81349	JAN1N982B	5961-00-752-6165	1	1310
81349	JAN2N1131	5961-00-081-8365	1	1370
81349	JAN2N1893	5961-00-853-2601	1	1410
81349	JAN2N2219A	5961-00-949-1432	1	1400
81349	JAN2N2905A	5961-00-949-1440	1	1390
81349	JAN2N3251A	5961-00-911-6015	1	1360
81349	JAN2N964	5961-00-226-8581	1	1380
63743	K46604		1	1190
72619	M32-1151-1631	5930-00-856-9116	1	1320
81349	M39003/01-2991	5910-00-007-3974	1	200
81349	M39003/01-3029	5910-00-164-2972	1	140
81349	M39012/21-0002	5935-00-853-7596	1	240
72982	NP0331-12PORM5PCT	5910-00-280-5122	1	50
81349	RCR07G100JS	5905-00-107-0656	1	300
81349	RCR07G101JS	5905-00-141-1183	1	360
81349	RCR07G102JS	5905-00-110-7620	1	440
81349	RCR07G103JS	5905-00-106-3666	1	560
81349	RCR07G104JS	5905-00-110-0388	1	610
81349	RCR07G105JS	5905-00-116-8554	1	710
81349	RCR07G121JS	5905-00-119-8812	1	370
81349	RCR07G123JS	5905-00-106-1278	1	580
81349	RCR07G124JS	5905-00-400-4528	1	620
81349	RCR07G132JS	5905-00-104-8362	1	450
81349	RCR07G134JS	5905-00-111-1681	1	640
81349	RCR07G154JS	5905-00-114-5339	1	650
81349	RCR07G184JS	5905-00-114-5344	1	660
81349	RCR07G2R7JS	5905-00-455-4403	1	280
81349	RCR07G202JS	5905-00-114-0708	1	460
81349	RCR07G220JS	5905-00-106-3668	1	310
81349	RCR07G222JS	5905-00-105-7764	1	470
81349	RCR07G224JS	5905-00-105-7765	1	670
81349	RCR07G225JS	5905-00-252-1671	1	720
81349	RCR07G270JS	5905-00-113-4860	1	320
81349	RCR07G274JS	5905-00-120-9152	1	680
81349	RCR07G3R0JS	5905-00-111-1692	1	290
81349	RCR07G302JS	5905-00-131-9729	1	480
81349	RCR07G331JS	5905-00-114-0710	1	380
81349	RCR07G333JS	5905-00-118-4559	1	590

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81349	RCR07G334JS	5905-00-485-4545	1	690
81349	RCR07G335JS	5905-00-126-6677	1	730
81349	RCR07G432JS	5905-00-136-8431	1	500
81349	RCR07G470JS	5905-00-104-8368	1	330
81349	RCR07G471JS	5905-00-120-9154	1	390
81349	RCR07G472JS	5905-00-114-0711	1	510
81349	RCR07G473JS	5905-00-141-0717	1	600
81349	RCR07G474JS	5905-00-105-7767	1	700
81349	RCR07G512JS	5905-00-111-1679	1	520
81349	RCR07G561JS	5905-00-105-7768	1	400
81349	RCR07G562JS	5905-00-141-0744	1	530
81349	RCR07G621JS	5905-00-136-3891	1	410
81349	RCR07G622JS	5905-00-228-5506	1	540
81349	RCR07G681JS	5905-00-135-6046	1	420
81349	RCR07G750JS	5905-00-106-9357	1	340
81349	RCR07G820JS	5905-00-104-8363	1	350
81349	RCR07G821JS	5905-00-119-8768	1	430
81349	RCR07G822JS	5905-00-104-8358	1	550
81349	RCR07G915JS	5905-00-456-0592	1	850
81349	RCR20G103JS	5905-00-141-0591	1	780
81349	RCR20G105JS	5905-00-104-5756	1	830
81349	RCR20G134JS	5905-00-121-4953	1	820
81349	RCR20G151JS	5905-00-108-6922	1	750
81349	RCR20G155JS	5905-00-116-8558	1	840
81349	RCR20G225JS	5905-00-114-5398	1	860
81349	RCR20G275JS	5905-00-252-1046	1	870
81349	RCR20G302JS	5905-00-114-5417	1	760
81349	RCR20G433JS	5905-00-114-5430	1	790
81349	RCR20G472JS	5905-00-141-0595	1	770
81349	RCR20G563JS	5905-00-114-5441	1	800
81349	RCR20G823JS	5905-00-114-5489	1	810
81349	RCR20G910JS	5905-00-141-1144	1	740
81349	RCR32G223JS	5905-00-369-6923	1	880
81349	RCR32G243JS	5905-00-247-8718	1	890
81349	RCR32G563JS	5905-00-247-8735	1	900
81349	RCR32G753JS	5905-00-484-0294	1	910
81349	RCR42G103JR	5905-00-184-7703	1	920
81349	RCR42G151JS	5905-00-173-1119	1	940
81349	RCR42G153JS	5905-00-005-2867	1	950
81349	RCR42G273JS	5905-00-152-8373	1	930
81349	RC07GF113J		1	570
81349	RNC60K2150FS	5905-00-285-1155	1	1010
81349	RNC70H2493BS		1	1150
81349	RNC70H4993BS		1	990
81349	RNC70K1003FS	5905-00-329-6085	1	1120
81349	RNC70K1503FS	5905-00-433-1182	1	1140
81349	RNC70K1652FS	5905-00-308-6474	1	1080
81349	RNC70K4872FS	5905-00-428-2355	1	1180
81349	RNC70K7682FS	5905-01-018-4274	1	1090
81349	RNR60C18R7FS	5905-01-173-7557	1	960
81349	RNR60C2490FS	5905-00-411-7501	1	1020

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81349	RNR60C3650FS	5905-00-411-7502	1	1030
81349	RNR60C4640FS	5905-00-461-8999	1	1040
81349	RNR60C71R5FS	5905-00-411-7503	1	980
81349	RNR60C9091FS	5905-00-285-0158	1	1050
81349	RNR60K1600DM		1	1000
81349	RNR65C1001FS	5905-00-255-3724	1	1060
81349	RNR70C1003FS	5905-00-490-0041	1	970
81349	RNR70C1503FS	5905-00-231-5223	1	1130
81349	RNR70C7503FS	5905-00-411-1914	1	1160
81349	RNR70K6652FM		1	1100
81349	RN70D28R0F		1	1070
81349	RW67V102	5905-00-879-3635	1	1210
03508	STD704	5961-00-923-9772	1	1260
03877	T12G	5961-00-617-5668	1	1250
18876	10156805-1	5910-00-916-3648	1	110
18876	10193242-003	5910-00-187-4419	1	210
80009	108-0057-00	5950-00-896-7453	1	220
80009	108-147	5950-00-815-7309	1	230
80009	120-0278-00	5950-00-913-5595	1	1330
80009	151-0108-00	5961-00-759-9392	1	1350
59873	152-0061-00	5961-00-905-6871	1	1230
56289	19C429	5910-00-919-4374	1	160
01295	2N967	5961-00-900-6703	1	1340
60705	20C89A3	5910-00-018-1097	1	170
80009	281-0538-00	5910-00-828-1455	1	120
80009	281-0574-00	5910-00-978-9113	1	70
56289	29C189A	5910-00-879-5921	1	30
72982	301-024X5P1271K	5910-00-948-8934	1	35
80009	308-0002-00	5905-00-898-1825	1	1200
80183	33C35A	5910-00-828-5705	1	130
56289	41C208	5910-00-702-8060	1	40
56289	44C56A4	5910-00-071-7360	1	10
11237	4962	5905-00-910-0763	1	1220
08806	5AB-T	6240-00-087-1731	1	270
56289	5C023224X0250B3	5910-00-081-0587	1	180
02114	55-590-65-3B	5950-00-015-6297	1	250
73445	7119	5960-00-800-0515	1	260
18876	9995445	5910-00-682-3249	1	20
18876	9995632-3		1	1170

☆ U.S. Government Printing Office: 1986-698-081/40162

APPENDIX A

REFERENCES

Following is a list of publications available to the Time Base Plug-In, Tektronix Type 3B4 operator and maintenance personnel.

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins and Lubrication Orders.
DA Pam 310-7	U. S. Army Equipment Index of Modification Work Orders.
SB 38-100	Preservation, Packaging, Packing, and Marking Materials, Supplies, and Equipment used by the Army.
TB 746-10	Field Instruction for Painting and Preserving Electronic Equipment.
TM 38-750	The Army Maintenance Management System (TAMMS).
TB 750-236	Calibration Requirements for the Maintenance of Army Materiel.

APPENDIX B

BASIC ISSUE ITEMS LIST

SECTION 1

INTRODUCTION

B-1 SCOPE

B-1.1. This appendix lists items which accompany the Time Base Plug-In, Tektronix Type 3B4 and are required for installation, operation, or maintenance.

B-2 GENERAL

B-2.1. This Basic Issue Items List is divided into the following sections:

(a) Basic Issues Items—Section 2. A list of items which accompany Time Base Plug-In, Tektronix type 3B4 and are required by the operator/crew for installation, operation, or maintenance.

(b) Maintenance and Operating Supplies—Section 3. Not applicable.

SECTION 2

BASIC ISSUE ITEMS LIST

Description	Mfr. Part No.
Instruction Manual	070-0431-00

APPENDIX C

MAINTENANCE ALLOCATION CHART

MAINTENANCE ALLOCATION CHART Date: 18 October 1968

Nomenclature of End Item or Component:
TIME BASE UNIT, 7912040-1

This Maintenance Allocation Chart designates overall responsibility for the performance of maintenance functions on the identified end item or component. The implementation of field maintenance tasks upon this end item or component will be consistent with the assigned maintenance operations which are defined as follows:

Operation	Definition
Depot	That level of logistics which has the facilities, personnel and capabilities to equal the quality of the equipment repair available at the contractor's facilities. (D)
Reference	That level in the maintenance of calibration equipment which provides DS and GS logistics support. (H)
Transfer	That level in the maintenance of calibration equipment which provides organizational and limited DS logistical support to Secondary Transfer equipment. (F)

MAINTENANCE ALLOCATION CHART FOR TIME BASE UNIT

CHART NUMBER 7912040-1

Group number	Functional group	Maintenance functions												
		a Inspect	b Test	c Service	d Adjust	e Align	f Calibrate	g Install	h Replace	i Repair	j Overhaul	k Rebuild	l Tool Reqd.	m Remarks
1	Time Base Unit	H	H	F	—	—	H	F	F	H	D	—	1	A
2	Switch, Wired-Time/CM	H	H	—	—	—	—	—	H	H	D	—	2	B

MAINTENANCE ALLOCATION CHART FOR TIME BASE UNIT

CHART NUMBER 7912040-1

TOOLS REQUIRED

Tool code	Category	Nomenclature	Tool number
1-b	H	Calibrator, Voltage	6625-555-2247
	H	Generator, Signal, UHF	4931-808-6627
	H	Generator, Square Wave	6625-542-1988
	H	Generator, Time Mark	4931-916-5945
	H	System, Graphic Display	4931-951-6291
	H	Voltmeter, Digital	4931-932-5034
	H	Adapter, Connector	5935-683-7892
	H	Adapter, Connector	5935-739-2243
	H	Adapter, Connector	5935-987-5922
	H	Cable Assembly, RF, 36 in.	4931-739-4412
	H	Cable Assembly, RF, 30 in.	4931-843-2792
	H	Probe, Standard	6605-774-9677
1-c	F	Cleaner, Electrical Contact	6850-973-3122
	F	Brush, Artist	8020-224-8022
	F	Brush, Dusting	7920-685-3980
	F	Clean Soft Cloth	7020-205-3571
	H	Calibrator, Voltage	6625-555-2247
	H	Generator, Signal, VHF	4931-808-6627
	H	Generator, Square Wave	6625-542-1988
	H	Generator, Time Mark	4931-916-5945
	H	System, Graphic Display	4931-951-6291
	H	Voltmeter, Digital	4931-932-5034
	H	Adapter, Connector - BNC "T" Type, 2 Jacks, 1 Plug	5935-683-7892
	H	Adapter, Connector - BNC Jack to N Plug	5935-739-2243
	H	Adapter, Connector - BNC Jack to Double Banana Plug	5935-987-5922
	H	Cable Assembly, Radio Frequency, 36 in.	4931-739-4412
	H	Cable Assembly, Radio Frequency, 30 in.	4931-843-2792
	H	Probe - Standard	6605-774-9677
	H	Tool Kit, Alignment, Electricians	5180-650-7821
1-i	H	Key, Socket Head Screw, 1/16	5120-198-5398
	H	Key, Socket Head Screw, .050	5120-198-5402
	H	Key Socket Head Screw, 5/84	5120-224-2504
	H	Bridge, Wheatstone	6625-585-3635
	H	Detector, Galvanometer	4931-788-0021
	H	Power Supply, Precision	4931-778-2688
	H	Cable Assembly, RF 3 Required	4931-846-0010
	H	Multimeter, Service	7904729
	H	Capacitance Measuring Assembly	4931-916-5952
	H	Cable Assembly, GR874 to GR874, 36 in.	4931-914-5949
	H	Screwdriver, Philips, No. 1	5120-293-3348
	H	Semiconductor Tester with Probe	4931-914-5185
	H	Heat Sink	(28493) 30A
	H	Bridge, Inductance	6625-777-4118
	H	Oscillator, Audio	4931-916-8255
	H	Tuned Amplifier & Null Detector	4931-650-6357
	H	Tool Kit, Electricians	5180-650-7821
	H	Soldering Iron	3439-800-8898
	H	Solder	3439-821-7674
1-j	D	Key, Socket Head Screw, 1/16	5120-198-5398
	D	Key, Socket Head Screw, .050	5120-198-5402
	D	Key, Socket Head Screw, 5/64	5120-224-2504
	D	Bridge, Wheatstone	6625-585-3635
	D	Detector, Galvanometer	4931-788-0021
	D	Power Supply, Precision	4931-778-2688
	D	Cable Assembly, RF 3 Required	4931-846-0010
	D	Multimeter, Service	7904729
	D	Capacitance Measuring Assembly	4931-916-5952

MAINTENANCE ALLOCATION CHART FOR TIME BASE UNIT

CHART NUMBER 7912040-1

TOOLS REQUIRED

Tool code	Category	Nomenclature	Tool number
	D	Cable Assembly, GR874 to GR874, 36 in.	4931-914-5949
	D	Screwdriver, Phillips No. 1	5120-293-3348
	D	Semiconductor Tester with Probe,	4931-914-5185
	D	Heat Sink	(28493) 30A
	D	Bridge, Inductance	6625-777-4118
	D	Oscillator, Audio	4931-916-8255
	D	Tuned Amplifier & Null Detector	4931-650-6357
	D	Tool Kit, Electricians	5180-650-7821
	D	Soldering Iron	3439-800-8898
	D	Solder	3439-821-7674
2-h	H	Pliers, Diagonal (Included in Tool Kit 5180-650-7821)	
	H	Pliers, Needle Nose (Included in Tool Kit 5180-650-7821)	
	H	Soldering Iron	3439-800-8898
	H	Solder	3439-821-7674
2-i	H	Tool Kit, Electricians	5180-650-7821
	H	Multimeter, Service	7904729
	H	Capacitance Measuring Assembly	4931-916-5952
	H	Cable Assembly, GR874 to GR874, 36 in.	4931-914-5949
	H	Bridge, Wheatstone	6625-585-3635
	H	Detector, Galvanometer	4931-788-0021
	H	Power Supply, Precision	4931-778-3688
	H	Cable Assembly, RF 3 Required	4931-846-0010
	H	Soldering Iron	3439-800-8898
	H	Solder	3439-821-7674
2-j	D	Tool Kit, Electricians	5180-650-7821
	D	Multimeter, Service	7904729
	D	Capacitance Measuring Assembly	4931-916-5952
	D	Cable Assembly, GR874 to GR874, 36 in.	4931-914-5949
	D	Bridge, Wheatstone	6625-585-3635
	D	Detector, Galvanometer	4931-788-0021
	D	Power Supply, Precision	4931-778-3688
	D	Cable Assembly, RF 3 Required	4931-846-0010
	D	Soldering Iron	3439-800-8898
	D	Solder	3439-821-7674

MAINTENANCE ALLOCATION CHART FOR TIME BASE UNIT

CHART NUMBER 7912040-1

REMARKS

Remarks code	Remark.
A-b	Test in accordance with Section II, Subparagraph "a" of Calibration Procedure TB 9-6625-1094-50.
A-c	Clean Components and Case periodically.
A-f	Calibrate in accordance with Section II, Subparagraph "b" of Calibration Procedure TB 9-6625-1094-50.
A-g	Install in Case No. 23, Drawer No. 1 of Calibration Van (M292A5)
A-i	Solder all connections per MIL-S-45743
A-j	Solder all connections per MIL-S-45743
B-h	Solder all connections per MIL-S-45743
B-i	Solder all connections per MIL-S-45743
B-j	Solder all connections per MIL-S-45743

By Order of the Secretary of the Army:

W. C. WESTMORELAND,
General, United States Army,
Chief of Staff.

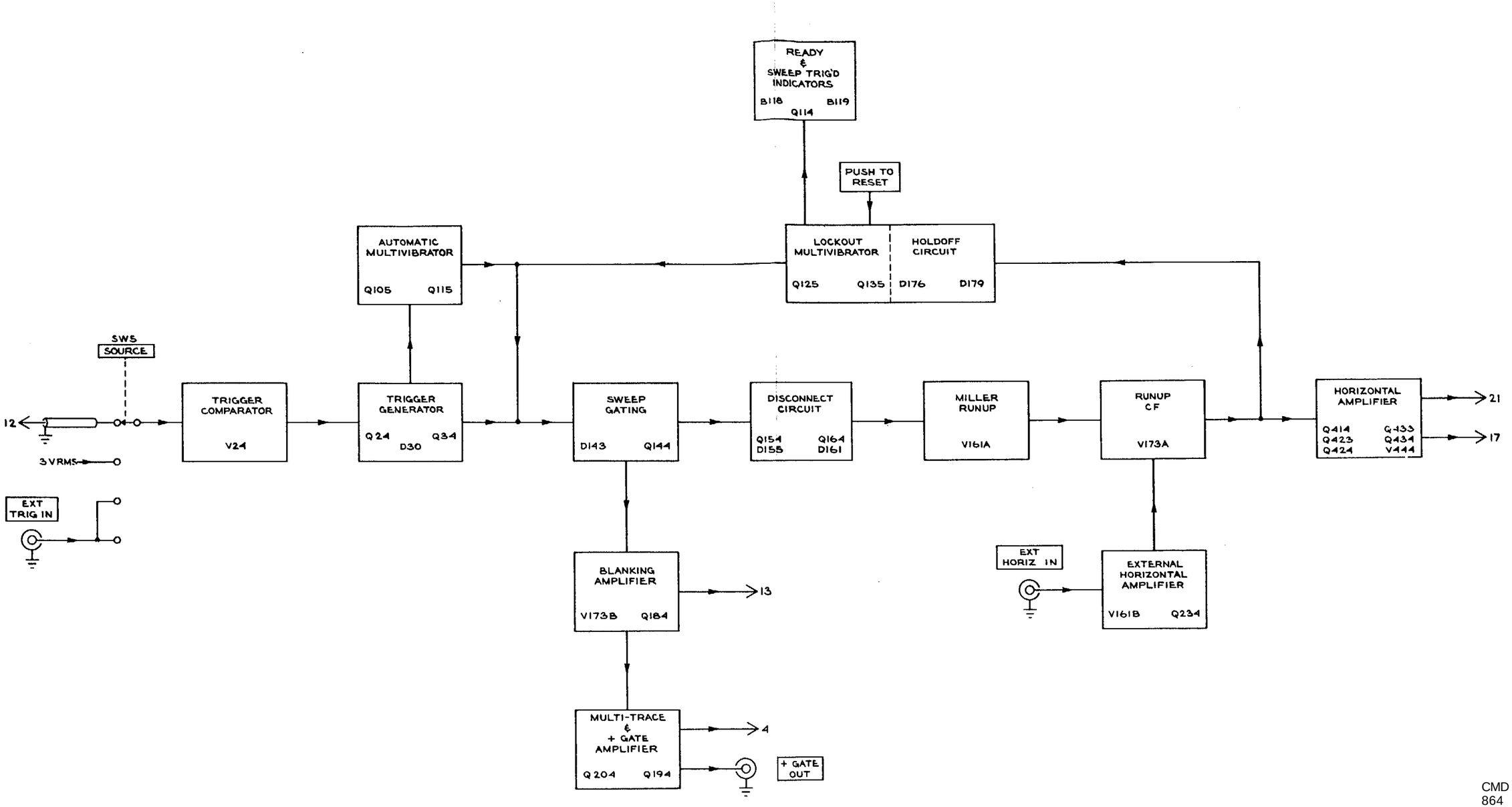
Official:

VERNE L. BOWERS,
Major General, United States Army,
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-34, Section II, (qty rqr block no. 75) Requirements for Calibration Procedure Publications.

☆ **U.S. GOVERNMENT PRINTING OFFICE: 1992 - 631-006/60075**



CMD 864

TYPE 3B4 PLUG-IN

BLOCK DIAGRAM

Figure 5-2

IMPORTANT:

All waveform photographs and quiescent voltages shown on the Type 3B4 schematics were taken from the crt of a Tektronix Type 543A/CA oscilloscope system. A 10X attenuator probe was used, and all units were calibrated.

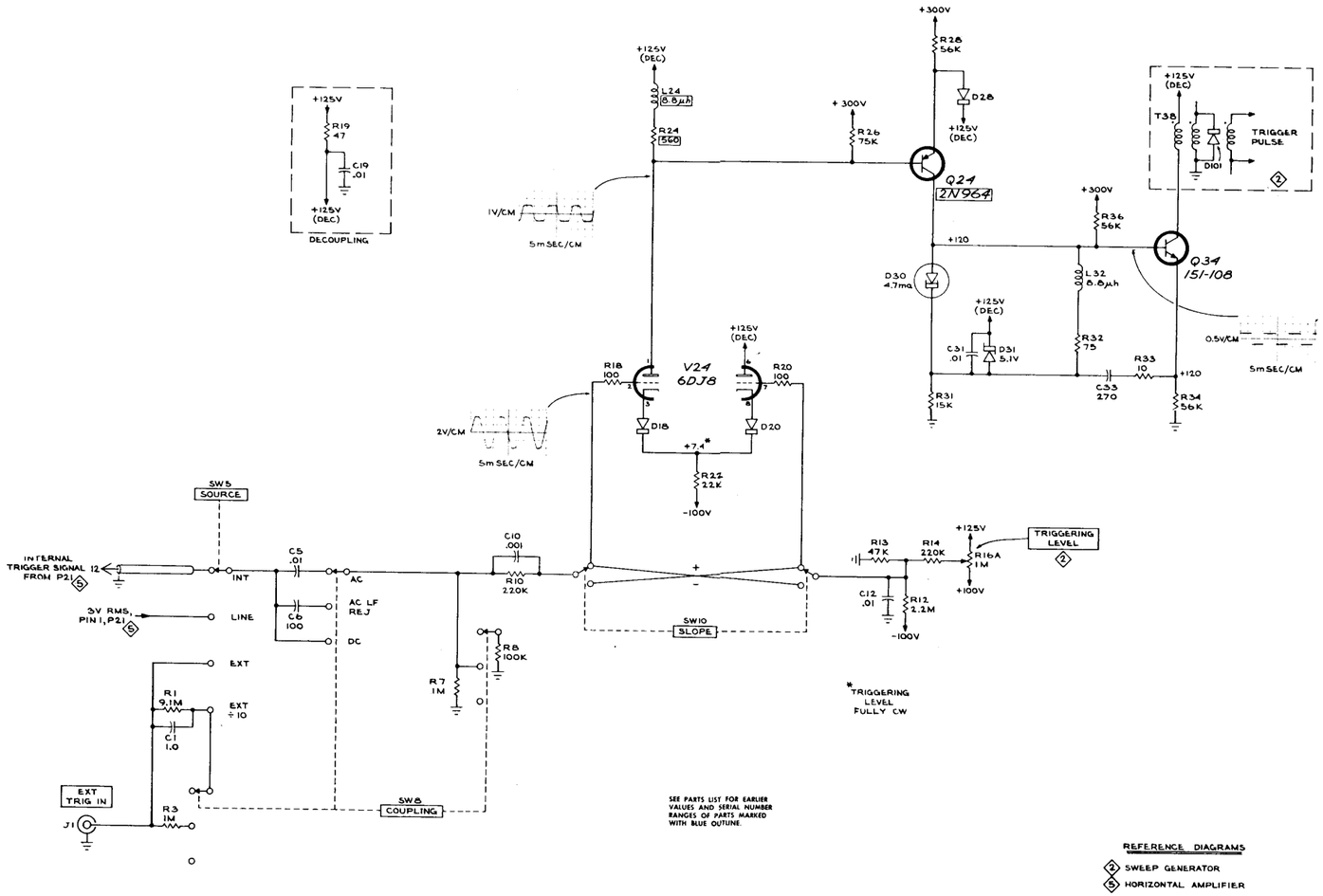
WAVEFORMS:

The settings of the Type 543A TIME/CM and the Type CA VOLTS/CM switches used in obtaining the waveforms are printed adjacent to the individual waveforms. AC coupling of the Type CA was used except for those waveform photographs where the 0 volt level is called out at the side of the photograph. The Type 3B4 TIME/DIV switch was set to 1 mSEC, the SOURCE switch to LINE, the COUPLING to AC, and the SLOPE to + for all photographs.

VOLTAGES:

In making the voltage measurements, the Type 3B4 SOURCE switch was set to EXT and the Type 3B4 was in its quiescent state (not triggered). The POSITION and FINE controls were set as for a centered trace. The TRIGGERING LEVEL control was centered for all voltage measurements except for the measurement at the junction of D18 and D20.

The voltages shown on the schematics are not absolute, but may vary slightly due to normal manufacturing tolerances.



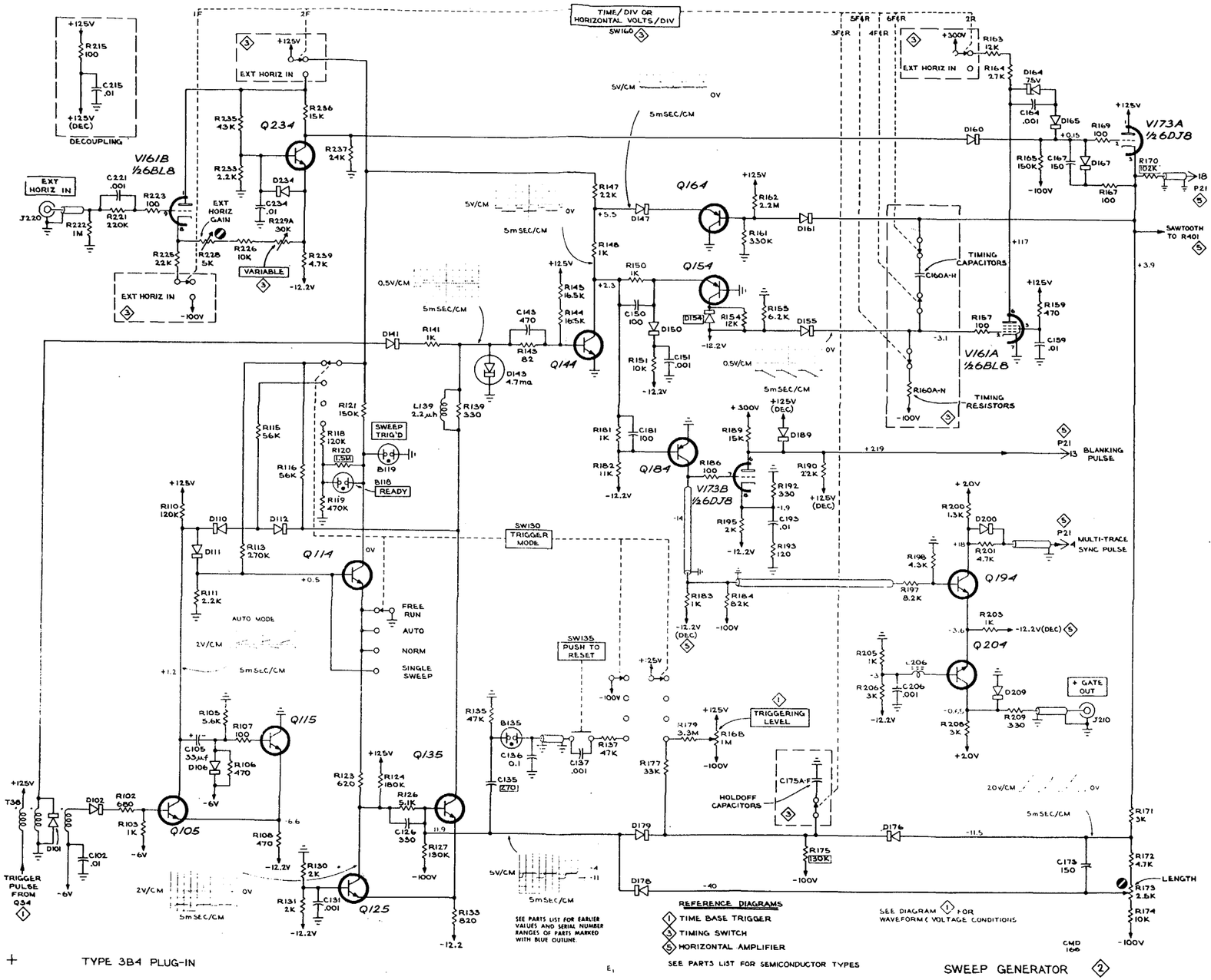

TIME/DIV OR HORIZONTAL VOLTS/DIV SW160
EXT HORIZ IN
V161B ½6BL8
Q234
Q164
Q154
Q144
V173A ½6DJ8
V161A ½6BL8
V173B ½6DJ8
Q184
Q114
Q115
Q105
Q135
Q125
Q194
Q204
TIMING CAPACITORS
TIMING RESISTORS
SAWTOOTH TO R401
BLANKING PULSE
MULTI-TRACE SYNC PULSE
+ GATE OUT
TRIGGERING LEVEL
HOLDOFF CAPACITORS
SWEEP TRIG'D
READY
SW130 TRIGGER MODE
FREE RUN
AUTO
NORM
SINGLE SWEEP
SW135 PUSH TO RESET
LENGTH
TRIGGER PULSE FROM Q34
REFERENCE DIAGRAMS
1 TIME BASE TRIGGER
3 TIMING SWITCH
5 HORIZONTAL AMPLIFIER
SEE PARTS LIST FOR SEMICONDUCTOR TYPES
SEE DIAGRAM 1 FOR WAVEFORM & VOLTAGE CONDITIONS
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
TYPE 3B4 PLUG-IN
SWEEP GENERATOR

Figure 5-4

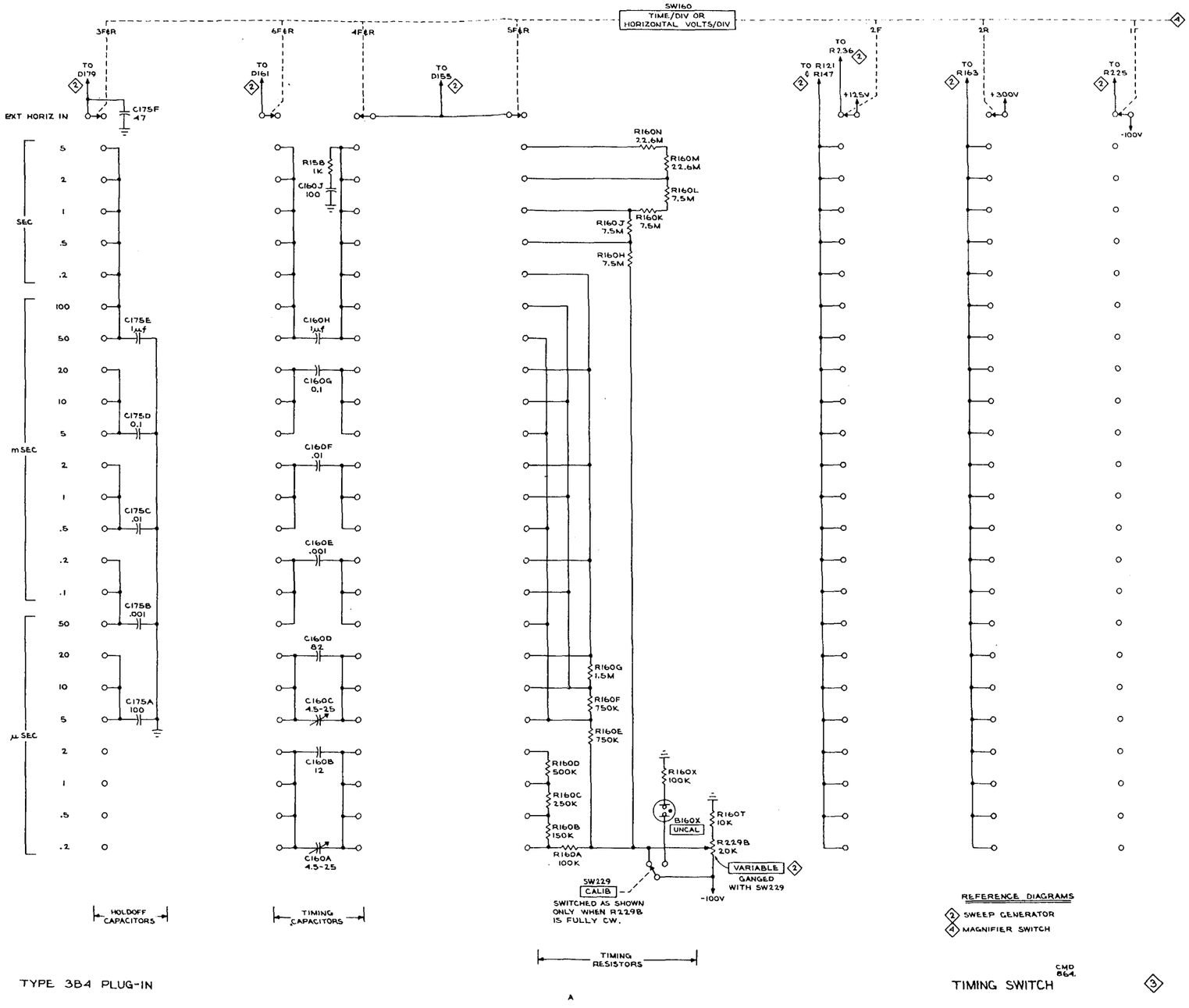
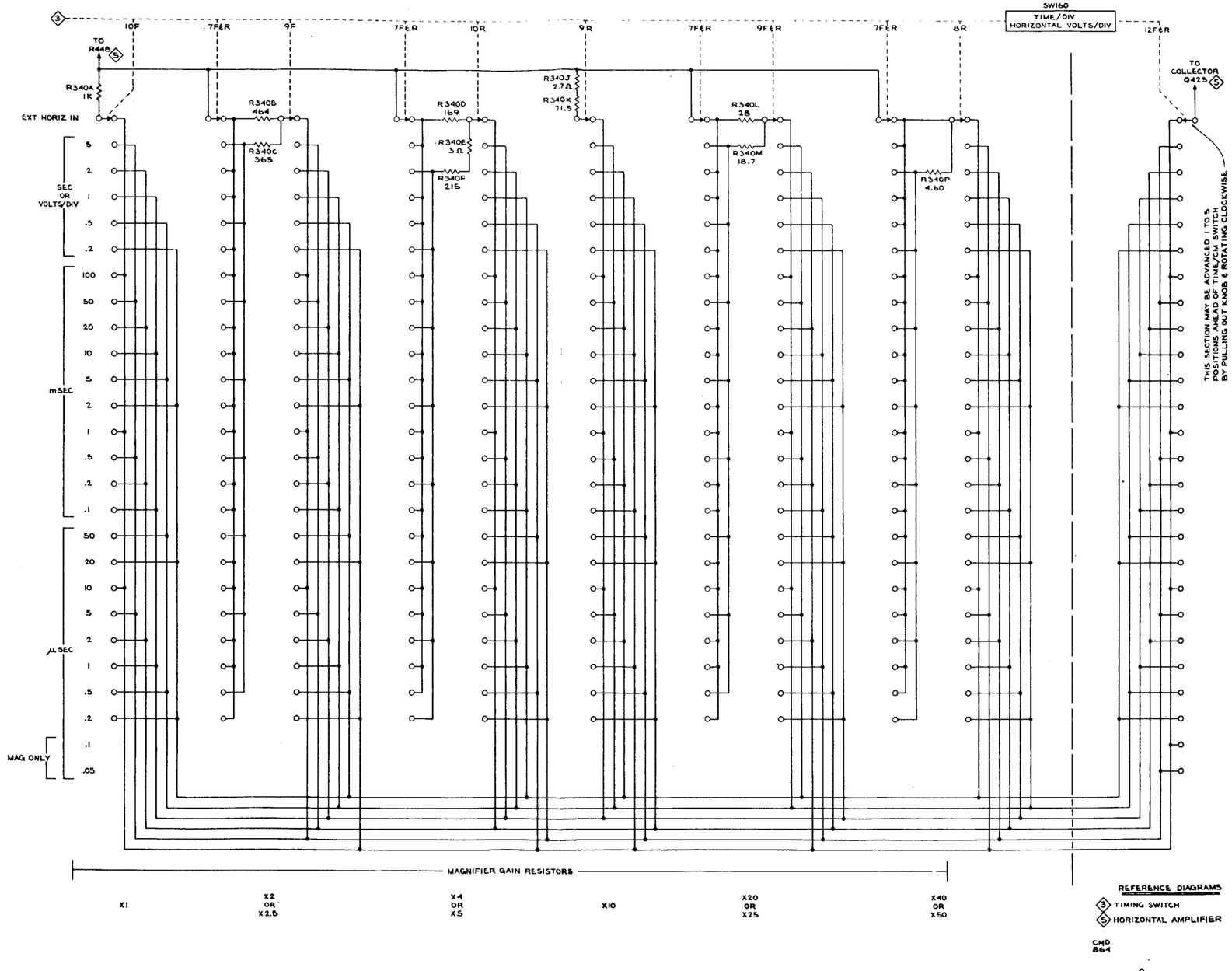
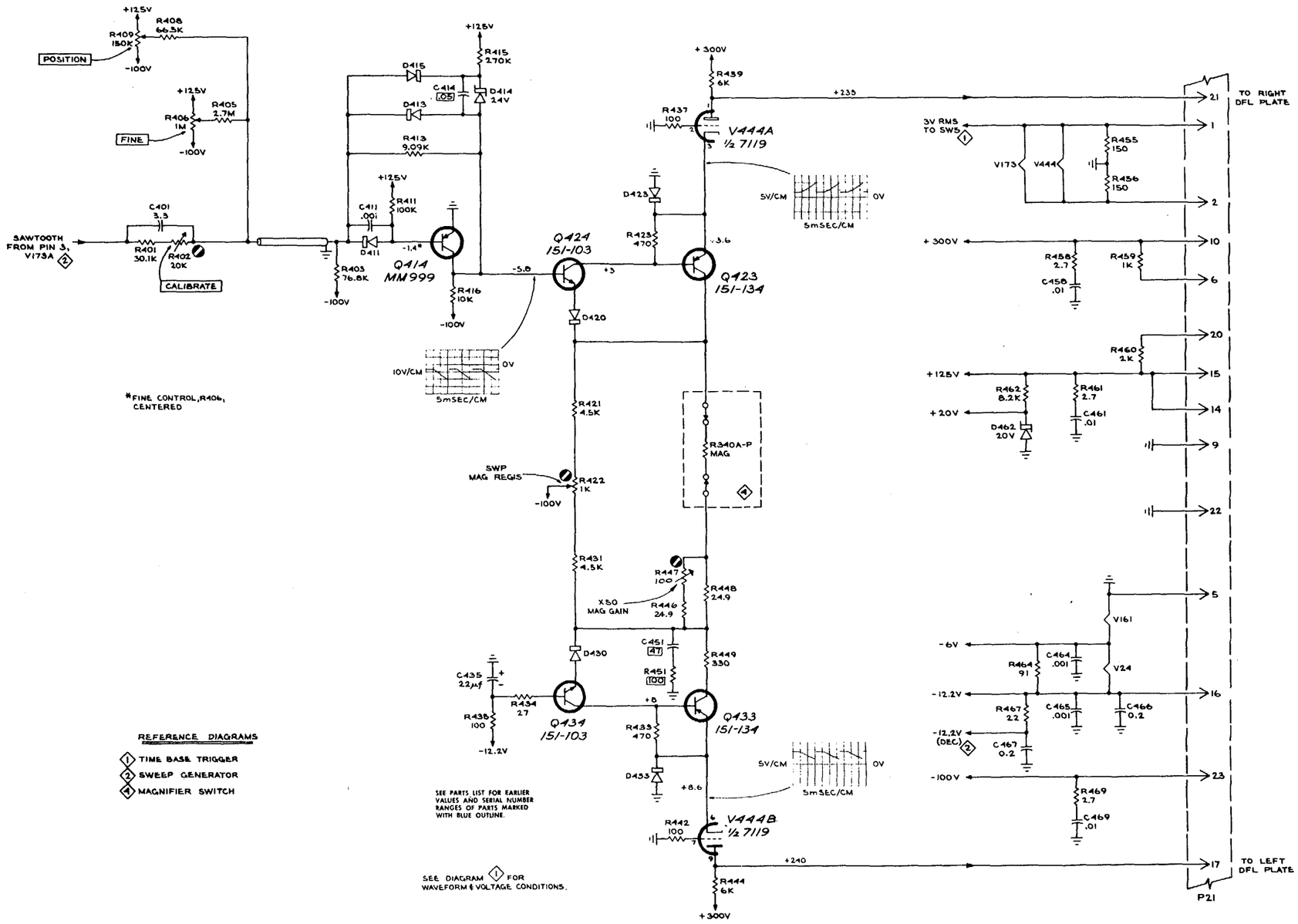

SW160
TIME/DIV OR
HORIZONTAL VOLTS/DIV
3F&R
6F&R
4F&R
5F&R
2F
2R
1F
TO D179
TO D161
TO D155
TO R236
TO R121 & R147
TO R163
TO R225
EXT HORIZ IN
C175F .47
+12.5V
+300V
-100V
SEC
mSEC
μSEC
5
2
1
.5
.2
100
50
20
10
5
2
1
.5
.2
.1
50
20
10
5
2
1
.5
.2
C175E 1μf
C175D 0.1
C175C .01
C175B .001
C175A 100
R158 1K
C160J 100
C160H 1μf
C160G 0.1
C160F .01
C160E .001
C160D 82
C160C 4.5-25
C160B 12
C160A 4.5-25
R160N 22.6M
R160M 22.6M
R160L 7.5M
R160K 7.5M
R160J 7.5M
R160H 7.5M
R160G 1.5M
R160F 750K
R160E 750K
R160D 500K
R160C 250K
R160B 150K
R160A 100K
R160X 100K
B160X
UNCAL
R160T 10K
R229B 20K
VARIABLE
GANGED WITH SW229
SW229
CALIB
SWITCHED AS SHOWN ONLY WHEN R229B IS FULLY CW.
-100V
HOLDOFF CAPACITORS
TIMING CAPACITORS
TIMING RESISTORS
REFERENCE DIAGRAMS
2 SWEEP GENERATOR
4 MAGNIFIER SWITCH
TYPE 3B4 PLUG-IN
A
CMD 864.
TIMING SWITCH
3

Figure 5-5



TYPE 3B4 PLUG-IN A MAGNIFIER SWITCH 4

Figure 5-6



REFERENCE DIAGRAMS

1 TIME BASE TRIGGER
2 SWEEP GENERATOR
4 MAGNIFIER SWITCH

CMD
1264

Figure 5-7