# INSTRUCTION MANUAL

Serial Number

# TYPE 3L5 SPECTRUM ANALYZER PLUG-IN UNIT

Tektronix, Inc.
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070-0630-00

# CONTENTS



Abbreviations and symbols used in this manual are based on or taken directly from IEEE Standard 260 "Standard Symbols for Units", MIL-STD-12B and other standards of the electronics industry. Change information, if any, is located at the rear of this manual.

# SECTION 1
# CHARACTERISTICS

The Type 3L5 Spectrum Analyzer Plug-in Unit is designed for use with Tektronix oscilloscopes[1] that accept the 3-series plug-ins. The analyzer plugs directly into the oscilloscope which provides the required power.

The Time Base Units with the serial numbers listed and below, require a modification (040-0413-00) to provide a sweep signal to the analyzer. Type 2B67-15180, Type 3B1-4040, Type 3B3-4270, Type 3B4-740.

The analyzer displays signal amplitude as a function of frequency for a selected portion of the spectrum. Frequency is displayed along the horizontal axis (dispersion) and signal amplitude on the vertical axis. Front panel controls provide a means to optimize the unit performance for a wide variety of application.

The following electrical characteristics apply over an ambient temperature range as indicated or between 0° C to 50° C provided the environmental ambient temperature has been stable for 4 hours; and provided also that an initial warmup period of 20 minutes, with power applied, is provided for the instrument to stabilize. The performance check procedure given in Section 5 of this manual provides a convenient method to check the Operating Requirements listed in this section.

## FREQUENCY DISPLAY (Horizontal Axis)

| Characteristic | Operating Requirements | Supplemental Information |
|---|---|---|
| Center Frequency Range | 50 Hz to 990 kHz | |
| Variable | ≥10 kHz at the Center Frequency of 990 kHz | Extends the Center Frequency to 1 MHz or higher |
| Accuracy | | VARIABLE control must be in the CAL position. The temperature coefficient (50 Hz/°C, 100 Hz/°C and 200 Hz/°C) applies after a stable ambient temperature period of 4 hrs., minimum. |
| 50 Hz to 990 Hz | ± (5% +50 Hz +50 Hz/°C max.) ≤ 1000 Hz change from 0° C to 50° C. | |
| 1000 Hz to 9900 Hz | ± (5% +100 Hz +100 Hz/° C max.) ≤ 2500 Hz change from 0° C to 50° C. | |
| 10 kHz to 99 kHz | ±(5% +3 kHz +200 Hz/°C) | |
| 100 kHz to 990 kHz | ±(5% +10 kHz +200 Hz/°C) | |
| Stability 50 Hz to 9900 Hz | ≤100 Hz/hr at a stable (±1°C) ambient temperature. | |
| Dispersion Range | | |
| Calibrated | 10 Hz to 100 kHz | In 9 Calibrated steps |
| Variable | From near 0 Hz to the indicated position of the Hz/DIV selector | |
| Accuracy Center Frequency 50 Hz to 9900 Hz 10 kHz to 990 kHz | ≤10% (20°C to 30°C) increasing to 20% (0°C to 50°C) | Measured over the center 8 divisions of the display. Upper limit of dispersion window must not exceed 10 kHz for the 50 Hz to 9900 Hz Center Frequency range, or 1MHz for the 10 kHz to 990 kHz Center Frequency range. Accuracy for a given Center Frequency can be improved with front panel calibration controls |
| Linearity | Within ±3% (20° C to 30° C) Within ±6% (0° C to 50° C) | |
| Resolution Bandwidth | ≤10 Hz to ≥500 Hz (20° C to 30° C) ≤20 Hz to ≥500 Hz (0° C to 50° C) | Within ±1 dB amplitude change at 25°C ±5° C. Can be manually coupled with the DISPERSION switch or uncoupled and switched separately |

[1]Type 565 must be modified to supply the Time Base sawtooth at pin 18 of the Interconnecting plug.

# SECTION 2

# OPERATING INSTRUCTIONS

## Introduction

A Spectrum Analyzer is an instrument that graphically presents a plot of amplitude as a function of frequency for a selected portion of the spectrum. The Type 3L5 is designed to provide a spectral display of the frequency distribution of electromagnetic energy within the frequency range of 50 Hz to 1 MHz. Signals are displayed as a spectrum on an associated oscilloscope CRT screen with signal energy plotted on the vertical axis against frequency on the horizontal axis.

This type of display provides the following information. The presence or absence of signals, their frequencies, frequency drift, relative amplitude of the signals and the nature of modulation if any, plus many other characteristics.

This section of the manual describes the function of the front panel controls and connectors, and a procedure for first time operation to introduce the operator to the functions of the controls. The remainder of the section then describes operating techniques with some measurement applications and signal interpretations.

## CONTROLS AND CONNECTORS

The following is a brief description of the operation or function of the controls and connectors on the front panel. See Fig. 2-1. A more detailed description is given later in this section under operating information.

CENTER FREQUENCY-Hz Selector

Tunes the center frequency of the display from 50 Hz to 990 kHz.

CENTER FREQUENCY CAL Adjustments

Calibrates the Center Frequency at 0000 Hz, 10 kHz and 500 kHz.

VARIABLE CENTER FREQUENCY Control

Provides a continuously variable, overlapping adjustment of the Center Frequency. Extends the center frequency to 1 MHz when the CENTER FREQUENCY-Hz selector is in the 990 K position.

POSITION Control

Vertically positions display.

VERTICAL DISPLAY Switch

LIN (RMS V/DIV)—Selects linear display mode

LOG—Selects a logarithmic display

VIDEO—Selects an analog display (frequency versus time). Use tinted VOLTS/DIV scale.

VIDEO CAL Adjustment—Calibrates vertical deflection factor, in peak to peak voltage, for VIDEO mode.

VOLTS/DIV Selector

Selects deflection factors from 0.1 V/div to 100 V/div (peak to peak) in VIDEO mode, and .001 V/div to 2 V/div (RMS) in the LIN mode. Selection is in a 1-2-5 sequence.

V/DIV ÷100 Switch

Extends minimum vertical deflection factor to 10 $\mu$V/div by increasing the vertical sensitivity by a factor of 100.

Input Coupling Selector

AC—Capacitively couples the input signal to the input amplifier.

GND—Grounds input amplifier.

AC FAST (DIRECT COUPLED)—Directly couples input signal to the input amplifier.

INPUT Connector

Connects signal to the unit. Maximum input, 300 volts (DC + peak AC). Input time constant, approximately 30 $\mu$s. (Approximately 30 pF paralleled by 1 megohm.)

DISPERSION

Hz/DIV Selector—Selects dispersion (frequency excursion of the display), from 10 Hz/DIV to 100 kHz/DIV.

VARIABLE Dispersion Control—Provides a continuously variable adjustment of dispersion from near zero to that selected by the Hz/DIV switch.

REDUCE Dispersion Indicator—Lights when improper settings of the CENTER FREQUENCY and DISPERSION controls are selected. Indicates that the display may be misleading. For example: 5 kHz Center Frequency with 10 kHz/Div dispersion.

5000 Hz C. F. CAL Adjustment—Calibrates the dispersion for the CENTER FREQUENCY-Hz selector range, 10 Hz to 9900 Hz.

30 kHz C. F. CAL Adjustment—Calibrates the dispersion for the CENTER FREQUENCY-Hz selector range, 10 kHz to 990 kHz.

COUPLED RESOLUTION Control

Control is coupled with the DISPERSION selector. Pull to vary resolution. Resolution range $\leq$ 10 Hz to $\geq$ 500 Hz.

SWEEP Control

Selects internal or manual sweep mode. In manual position it provides a means to manually sweep the display.

Sweep Manual OUT Jack

Banana output jack that provides a DC output voltage with respect to the position of the Manual Sweep control. When

# SECTION 3
# CIRCUIT DESCRIPTION

## Introduction

The Type 3L5 Spectrum Analyzer is a swept front end spectrum amplifier covering the frequency range from 10 Hz to 1 MHz. This section presents first a block diagram analysis, then a detailed circuit description of the individual circuits within each block.

Schematic diagrams showing all circuit components are located on the pull-out pages of Section 9, along with a detailed block diagram. Simplified diagrams are used in this section to help illustrate general circuit theory of operation. Refer to section 9 for detailed diagrams.

## BASIC DESCRIPTION

A simplified block diagram is shown in Fig. 3-1. This, along with the black diagram in Section 9, is used to describe the sequence of operation.

Incoming signals applied to the INPUT connector are fed through a calibrated attenuator and amplifier circuit, to establish the desired signal amplitude on the display. The signals are then coupled to the 1st mixer circuit where they are mixed with the swept frequency output of the 1st local oscillator. The intermediate frequencies from the 1st mixer are amplified and fed through a filter circuit, with a 3 MHz center frequency, to the 2nd mixer. Spurious signals outside the 2.97 to 3.03 MHz bandpass of the filter are attenuated.

The 3 MHz IF signal is mixed with a 3.1 MHz 2nd local oscillator frequency and the 2nd intermediate frequency of 100 kHz is then applied through a variable resolution amplifier. The variable resolution amplifier provides a variable resolution bandwidth for the analyzer from $\leq$10 Hz to $\geq$500 Hz, by providing an adjustment of the bandwidth for the 100 kHz 2nd IF response.

The signal is then applied through a driver stage to both the recorder detector and the analyzer detector. The output video signal from the detector is attenuated through either a logarithmic or linear attenuator circuit for either a logarithmic or linear display. It is then amplified by a buffer and amplifier stage which drives the vertical deflection plates of the CRT in the associated oscilloscope.

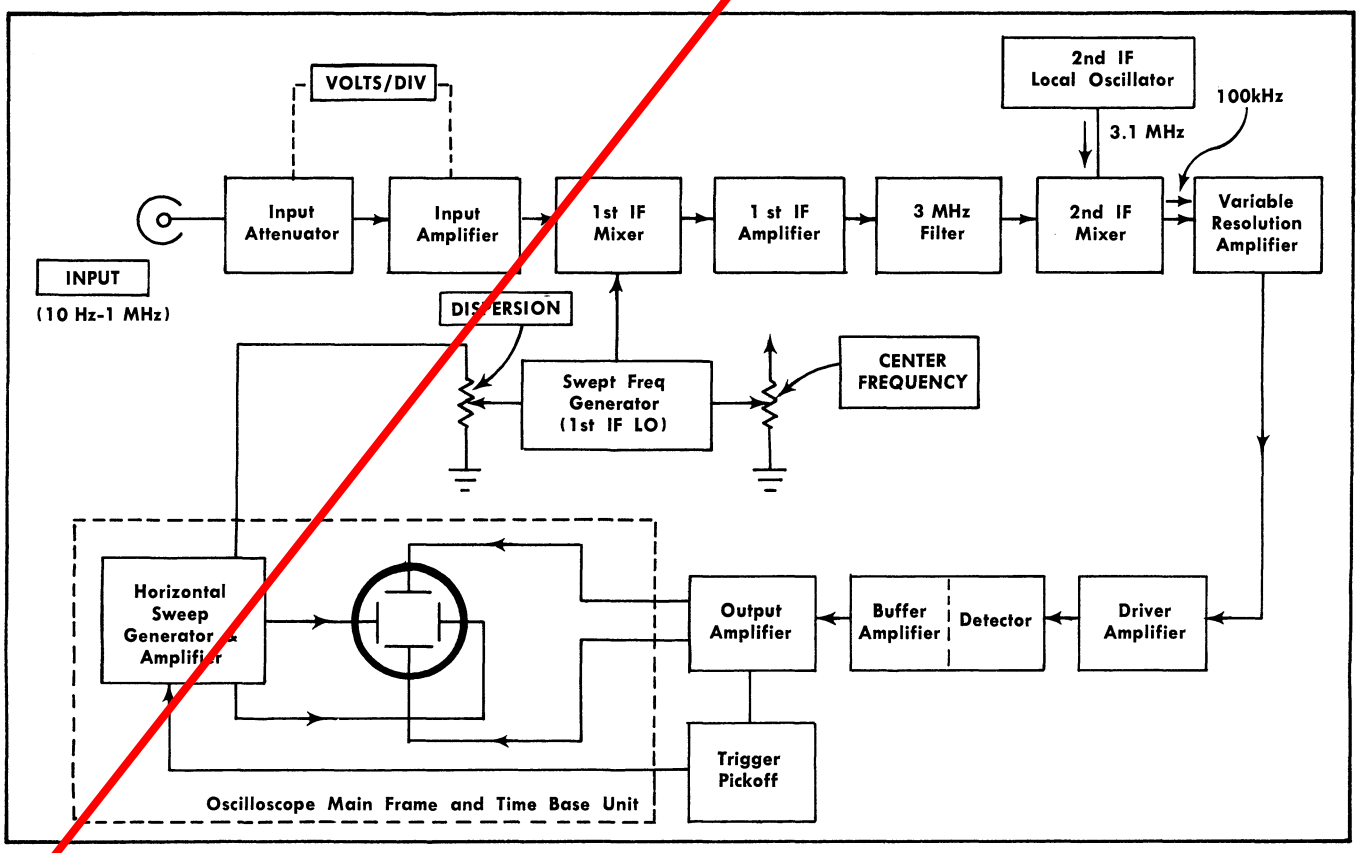


Fig. 3-1. Block diagram of basic circuits.

# SECTION 4

# MAINTENANCE

## Introduction

This section of the manual pertains to the maintenance and troubleshooting of the Type 3L5. The first portion describes some general preventive measures to help minimize major problems. This is then followed by some maintenance techniques and information on replacing components and circuit boards. The section concludes with some troubleshooting information.

## PREVENTIVE MAINTENANCE

### General

Preventive maintenance consists of cleaning, visual inspection, lubrication, and if needed, recalibration. Preventive maintenance is generally more economical than corrective maintenance, since it can usually be done during idle periods at a time convenient to the user. The preventive maintenance schedule established for the instrument should be based on the amount of use and the environment in which the instrument is used.

We recommend servicing and recalibration after each 500-hour period of operation, or more frequently if the instrument is usually operated under adverse conditions (such as a high temperature or a dusty or corrosive atmosphere). Even if the instrument is used only occasionally, it should be serviced and recalibrated at least once every six months.

### Exterior Cleaning

Loose dust accumulated on the outside of the instrument can be removed with a soft cloth or small paint brush. The paint brush is particularly useful for dislodging dirt on and around the front-panel controls. Dirt which remains can be removed with a soft cloth dampened in a mild solution of water and detergent. Abrasive cleaners should not be used.

CAUTION

**Avoid the use of chemical cleaning agents which might damage the plastic and paint used in this instrument. Some chemicals to avoid are benzene, toluene, xylene, acetone or similar solvents.**

### Interior Cleaning

Dust in the interior of the instrument should be removed occasionally due to its electrical conductivity under high-humidity conditions. The best way to clean the interior is to blow off the accumulated dust with dry, low-velocity air. Remove any dirt which remains with a soft paint brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces or for cleaning ceramic terminal strips and circuit boards.

### Lubrication

The reliability of potentiometers, rotary switches and other moving parts can be increased if they are kept properly lubricated. Use a cleaning-type lubricant (such as Tektronix Part No. 006-0218-00) on shaft bushings and switch contacts. Lubricate switch detents with a heavier grease (such as Tektronix Part No. 006-0219-00). Potentiometers should be lubricated with a lubricant which will not affect electrical characteristics (such as Tektronix Part No. 006-0220-00). Do not over-lubricate. A lubrication kit containing the necessary lubricant and instructions is available from Tektronix. Order Tektronix Part No. 003-0342-00.

### Visual Inspection

After a thorough cleaning, the instrument should be carefully inspected for such defects as poor connections, damaged parts and improperly seated transistors. The remedy for most visible defects is obvious; however, if heat-damaged parts are discovered, determine the cause of overheating before the damaged parts are replaced; otherwise, the damage may be repeated.

### Transistor Checks

Periodic preventive maintenance checks, consisting only of removing transistors from the instrument and testing them in a tester, are not recommended. The circuits within the instrument provide the only satisfactory check on transistor performance. Defective transistors are usually detected during recalibration of the instrument. Details of in-circuit transistors checks are given in the troubleshooting procedure later in this section.

### Performance Checks and Recalibration

To insure accurate measurements, the instrument performance should be checked after each 500 hours of operation or every six months if the instrument is used intermittently. The calibration procedure is an aid in the isolation or major troubles in the instrument, and in location of minor troubles which may not be apparent during regular operation. Instructions on how to conduct a performance check are given in Section 5 Calibration instructions are described in Section 6.

## CORRECTIVE MAINTENANCE

Corrective maintenance consists of component replacement and instrument repair. Special techniques or pro-

# SECTION 5

# PERFORMANCE CHECK

This section of the manual provides a means of checking the performance of the Type 3L5. It is intended to check the calibration of the instrument without performing the complete Calibration Procedure. The Performance Check does not include the adjustment of any internal controls. Failure to meet the requirements given in this procedure indicates the need for internal checks or adjustments, details of which will be found in the Calibration Procedure.

## Recommended Equipment

The following equipment is recommended for a complete performance check. Specifications given are the minimum necessary to perform this procedure. All equipment must be calibrated and operating within the original specifications. If equipment is substituted, it must meet or exceed the specifications of the recommended equipment.

For accuracy and convenience, special calibration fixtures may be used in this procedure. These fixtures are available from Tektronix, Inc. Order by part number through your local Tektronix Field Office or representative.

## Equipment List

1. Plug-In Oscilloscope. Tektronix Type 564 or 561A with a 2B- or 3B-series time-base plug-in unit. The oscilloscope square-wave transient response must be correct for the Type 3L5 to make bandpass characteristics. Adjust, by using the 560-Series CRT Capacitance Standardizer; Tektronix Part Number 067-0500-00. This oscilloscope should be the oscilloscope in which the Type 3L5, being calibrated, will normally be used, because the front panel adjustments will have to be reset if the analyzer is changed to another oscilloscope. A Type 564 Storage Oscilloscope with a Type 3B4 Time-Base Plug-In Unit is used for this procedure.

2. Test Oscilloscope. Minimum requirements: Bandwidth, DC to 10 MHz; vertical sensitivity and accuracy, 0.005 V/Div to 10 V/Div, ±3%; sweep rate and accuracy, 1 s/div to .2 μs/div, ±3%. Tektronix 540, 550 or 560 series with appropriate plug-in units. For example: 545B with the Type 1A1 Plug-In Unit.

3. Time-Mark Generator. Minimum requirements: Marker output, 50 ms (20 Hz) to 10 μs (100 kHz); marker accuracy, within ±.001%. Tektronix Type 184 Time-Mark Generator.

4. Two, (2) Wide-Range Signal Generators. Minimum requirements: Frequency output and accuracy, 10 Hz to 1 MHz, ±1%; output amplitude, ≥2 volts peak to peak. Hewlett-Packard Type 241A Oscillator or General Radio Type 1310-A.

5. Square-Wave Generator. Minimum requirements: Repetition Rate, 1 kHz; risetime, ≤15 nanoseconds; output amplitude, variable between 0.5 volts and 10 volts. Tektronix Type 106 Square-Wave Generator.

6. Standard Amplitude Calibrator (SAC). Minimum requirements; Output amplitude and accuracy, 0.005 volts to 100 volts, ±0.3%. Tektronix Part Number 067-0502-00.

7. Probes:

a. P6006, 10× Passive Probe. Tektronix Part Number 010-0127-00.

b. P6011, 1× Passive Probe. Tektronix Part Number 010-0193-00.

8. Input RC Normalizer: RC = 1 MΩ × 30 pF, equipped with BNC connectors. Tektronix Part Number 067-0552-00.

9. Three (3) 50 Ω coaxial cables. 42 inches long, BNC connector. Tektronix Part Number 012-0057-00.

10. Patch cord with BNC to banana plug tips. Tektronix Part Number 012-0091-00.

11. Termination, 50 Ω BNC. Tektronix Part Number 011-0049-00.

12. Four (4), 50 Ω, 10:1 attenuators, BNC connectors. Tektronix Part Number 011-0059-00.

13. Three (3), 50 Ω, 5:1 attenuators, BNC connectors. Tektronix Part Number 011-0060-00.

14. BNC T connector, male to female. Tektronix Part Number 103-0030-00.

15. Binding post to BNC plug. General Radio, Type 274-QBJ.

16. Miniature phone plug and 600 Ω load. Test fixture to check TO RECORDER signal amplitude. Consists of a 600 Ω, 5%, ½ watt resistor soldered across a miniature phone plug. See item 17 of Fig. 6-2.

## PERFORMANCE CHECK PROCEDURE

### General

In the following procedure, test equipment connections or control settings should not be changed except as noted. If only a partial check is desired, refer to the preceding step(s) for setup information.

The following procedure uses the equipment listed under Recommended Equipment. If substitute equipment is used, control settings or setup must be altered to the requirements of the equipment used.

Some of the checks in this procedure require the use of a test oscilloscope and it is referred to in these terms. The oscilloscope associated with the 3L5 is referred to as a plug-in oscilloscope.

# SECTION 6
# CALIBRATION

## Introduction

This spectrum analyzer is a stable laboratory instrument which should not require frequent recalibration. Its performance should be checked however, as directed in Section 5, approximately every 500 hours of operation or every six months if used intermittently. This will assure proper operation or indicate the section of the instrument that needs recalibration.

This calibration procedure is arranged in a sequence which will allow the instrument to be checked and calibrated with the least interaction of adjustments and reconnecting of test equipment. A single step can usually be preformed, provided interaction between steps and adjustments is considered. However, because of the interaction between most circuits, the most satisfactory results will be attained if the complete calibration is performed.

Preliminary control settings and equipment setup are given at the start of each step of the procedure; however, it is advisable to check the preceding major setup in some cases for complete control settings and test equipment setup. Front panel control settings for the Type 3L5 are printed in capital letters and changes in these control settings from the previous setup are printed in bold type. Internal adjustments, the associated oscilloscope and the test equipment controls, are printed with initial capital letters.

## RECOMMENDED EQUIPMENT
## (See Figs. 6-1 and 6-2)

## General

The following equipment or its equivalent is recommended for complete calibration of this plug-in unit. Specifications given are the minimum necessary for accurate calibration of the instrument and should not be construed as advertised performance characteristics. If the instrument performs within the guide tolerances given in this procedure, it will meet all characteristics listed in Section 1 of this manual. All test equipment is assumed to be correctly calibrated and operating within the original specifications. If other equipment must be substituted for the recommended equipment, it must meet or exceed the specifications given in the following list.

Special calibration fixtures are recommend where necessary for the quickest and most accurate calibration. Order these fixtures, by part number, through your local Tektronix Field Office or representative.

NOTE

**When performing a complete recalibration, best performance will be provided if each adjustment is made to the exact setting, even if the check is within the allowable tolerance.**

## Equipment List

1. Plug-In Oscilloscope. Tektronix Type 564 or 561A with a 2B- or 3-B-series time-base plug-in unit. The oscilloscope square-wave transient response must be correct for the Type 3L5 to make bandpass characteristics. Adjust by using the 560-series CRT Capacitance Standardizer, Tektronix Part Number 067-0500-00. This oscilloscope should be the oscilloscope in which the Type 3L5, being calibrated, will normally be used, because the front panel adjustments will have to be reset if the analyzer is changed to another oscilloscope. A Type 564 Storage Oscilloscope with a Type 3B4 Time-Base Plug-In Unit is used for this procedure.

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5. Square-Wave Generator. Minimum requirements: Repetition rate, 1 kHz; risetime, ≤15 nanoseconds; output amplitude, variable between 0.5 volts and 10 volts. Tektronix Type 106 Square-Wave Generator.

6. Standard-Amplitude Calibrator (SAC). Minimum requirements: Output amplitude and accuracy, 0.005 volts to 100 volts, ±0.3%. Tektronix Part Number 067-0502-00.

7. Probes:

a. P6006 10× Passive Probe. Tektronix Part Number 010-0127-00.

b. P6011 1× Passive Probe. Tektronix Part Number 010-0193-00.

8. Flexible extension (allows the Spectrum Analyzer to be operated out of the oscilloscope plug-in compartment). Tektronix Part Number 012-0066-00.

9. Input RC Normalizer: RC = 1 MΩ × 30 pF, equipped with BNC connectors. Tektronix Part Number 067-0552-00.

10. Three (3), 50 Ω coaxial cables. 42 inches long, BNC connectors. Tektronix Part Number 012-0057-00.

11. Patch Cord with BNC to banana plug tips. Tektronix Part Number 012-0091-00.

# SECTION 7

# ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

| Ckt. No. | Tektronix Part No. | Serial/Model No. Eff | Disc | Description | | | |
|---|---|---|---|---|---|---|---|
| | | | | **Bulb** | | | |
| B115 | 150-0035-00 | | | Neon AID T2 | | | |
| | | | | **Capacitors** | | | |
| Tolerance ±20% unless otherwise indicated. | | | | | | | |
| C1 | *285-0697-01 | | | 0.1 μF | MT | 600 V | |
| C4A | 281-0503-00 | | | 8 pF | Cer | 500 V | ±0.5 pF |
| C4B | 281-0102-00 | | | 1.7-11 pF, Var | Air | | |
| C4C | 281-0099-00 | | | 1.3-5.4 pF, Var | Air | | |
| C4D | 281-0509-00 | | | 15 pF | Cer | 500 V | 10% |
| C5A | 281-0504-00 | | | 10 pF | Cer | 500 V | 10% |
| C5B | 281-0102-00 | | | 1.7-11 pF, Var | Air | | |
| C5C | 281-0099-00 | | | 1.3-5.4 pF, Var | Air | | |
| C5D | 283-0606-00 | | | 250 pF | Mica | 500 V | 10% |
| C8A | 281-0099-00 | | | 1.3-5.4 pF, Var | Air | | |
| C8C | 281-0102-00 | | | 1.7-11 pF, Var | Air | | |
| C8D | 281-0505-00 | | | 12 pF | Cer | 500 V | 10% |
| C9A | 281-0102-00 | | | 1.7-11 pF, Var | Air | | |
| C9C | 281-0102-00 | | | 1.7-11 pF, Var | Air | | |
| C10 | 281-0100-00 | | | 1.4-7.3 pF, Var | Air | | |
| C11 | 281-0500-00 | B010100 | B069999 | 2.2 pF | Cer | 500 V | ±0.5 pF |
| C11 | 281-0524-00 | B070000 | | 1.5 pF | Cer | 500 V | ±0.25 pF |
| C13 | 281-0078-00 | | | 1.4-7.3 pF, Var | Air | | |
| C15 | 281-0092-00 | B010100 | B069999 | 9-35 pF, Var | Cer | | |
| C15 | 281-0075-00 | B070000 | | 5-25 pF, Var | Cer | | |
| C16 | 283-0552-00 | | | 200 pF | Mica | 500 V | 1% |
| C18 | 283-0079-00 | | | 0.01 μF | Cer | 250 V | |
| C19 | 290-0267-00 | | | 1 μF | Elect. | 35 V | |
| C26 | 290-0164-00 | | | 1 μF | Elect. | 150 V | |
| C30 | 283-0079-00 | | | 0.01 μF | Cer | 250 V | |
| C34 | 283-0079-00 | | | 0.01 μF | Cer | 250 V | |
| C35 | 290-0167-00 | | | 10 μF | Elect. | 15 V | |
| C36 | 290-0167-00 | | | 10 μF | Elect. | 15 V | |
| C40 | 281-0540-00 | | | 51 pF | Cer | 500 V | 5% |
| C41 | 281-0543-00 | | | 270 pF | Cer | 500 V | 10% |
| C43 | 290-0201-00 | | | 100 μF | Elect. | 15 V | |
| C44 | Selected | | | | | | |

# SECTION 8

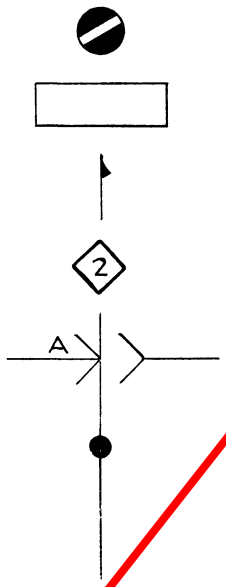
# MECHANICAL PARTS LIST

## FIG. 1 FRONT & SWITCHES

| Fig. & Index No. | Tektronix Part No. | Serial/Model No. Eff | Serial/Model No. Disc | Qty | 1 2 3 4 5 | Description |
|---|---|---|---|---|---|---|
| 1-1 | 366-0166-00 | | | 1 | | KNOB, charcoal—CENTER FREQUENCY—Hz (UNITS) |
| | - - - - - - | | | - | | knob includes: |
| | 213-0004-00 | | | 1 | | SCREW, set, 6-32 x 3/16 inch, HSS |
| -2 | 366-0169-00 | | | 1 | | KNOB, charcoal—CENTER FREQUENCY—Hz (TENS) |
| | - - - - - - | | | - | | knob includes: |
| | 213-0004-00 | | | 1 | | SCREW, set, 6-32 x 3/16 inch, HSS |
| -3 | 262-0785-00 | | | 1 | | SWITCH, wired—CENTER FREQUENCY—Hz (TENS) |
| | - - - - - - | | | - | | switch includes: |
| | - - - - - - | | | 1 | | SWITCH, unwired |
| -4 | - - - - - - | | | 6 | | BOARD, circuit |
| | - - - - - - | | | - | | mounting hardware: (not included w/switch) |
| -5 | 210-0419-00 | | | 1 | | NUT, hex., shouldered, 3/8-32 x 0.500 inch |
| -6 | 210-0001-00 | | | 2 | | LOCKWASHER, internal, #2 |
| -7 | 210-0405-00 | | | 2 | | NUT, hex., 2-56 x 3/16 inch |
| -8 | 407-0331-00 | | | 1 | | BRACKET, switch mounting |
| | - - - - - - | | | - | | mounting hardware: (not included w/bracket) |
| -9 | 211-0008-00 | | | 2 | | SCREW, 4-40 x 1/4 inch, PHS |
| -10 | 210-0801-00 | | | 2 | | WASHER, flat, 0.140 ID x 0.281 inch OD |
| -11 | - - - - - - | | | 1 | | RESISTOR, variable |
| | - - - - - - | | | - | | mounting hardware: (not included w/resistor) |
| -12 | 210-0940-00 | | | 1 | | WASHER, flat, 1/4 ID x 3/8 inch OD |
| -13 | 210-0583-00 | | | 1 | | NUT, hex., 1/4-32 x 5/16 inch |
| -14 | 366-0369-00 | | | 1 | | KNOB, red—CAL—VARIABLE |
| | - - - - - - | | | - | | knob includes: |
| | 213-0004-00 | | | 1 | | SCREW, set, 6-32 x 3/16 inch, HSS |
| -15 | 366-0370-01 | | | 1 | | KNOB, charcoal—MULTIPLIER |
| | - - - - - - | | | - | | knob includes: |
| | 213-0004-00 | | | 1 | | SCREW, set, 6-32 x 3/16 inch, HSS |
| -16 | 262-0786-00 | | | 1 | | SWITCH, wired—MULTIPLIER |
| | - - - - - - | | | - | | switch includes: |
| - | 260-0810-00 | | | 1 | | SWITCH, unwired |
| -17 | - - - - - - | | | 1 | | RESISTOR, variable |
| | - - - - - - | | | - | | mounting hardware: (not included w/resistor) |
| -18 | 210-0046-00 | | | 1 | | LOCKWASHER, internal, 1/4 ID x 0.400 inch OD |
| -19 | 210-0583-00 | | | 2 | | NUT, hex., 1/4-32 x 5/16 inch |
| -20 | 376-0050-00 | | | 1 | | ASSEMBLY, coupling |
| | - - - - - - | | | - | | assembly includes: |
| | 213-0022-00 | | | 4 | | SCREW, set, 4-40 x 3/16 inch, HSS |
| -21 | 354-0251-00 | | | 2 | | RING, coupling |
| -22 | 376-0046-00 | | | 1 | | COUPLING, plastic, 0.375 x 0.424 inch |
| -23 | 384-0418-00 | | | 1 | | SHAFT, extension |
| | - - - - - - | | | - | | mounting hardware: (not included w/switch) |
| -24 | 210-0419-00 | | | 1 | | NUT, hex., shouldered, 3/8-32 x 0.500 inch |

# SECTION 9
# DIAGRAMS

The following symbols are used on the diagrams:




Screwdriver adjustment

Front, side, or rear-panel control on connector

Clockwise control rotation in direction of arrow

Refer to indicated diagram

Connection to circuit board made with pin connector at indicated pin

Connection soldered to circuit board

Blue line encloses components located on circuit board

**IMPORTANT**

Circuit voltages were measured with a DC coupled oscilloscope. All readings are in volts with chassis ground as the reference unless otherwise noted on the diagram.

Waveforms shown are actual waveform photographs, taken with a Tektronix Oscilloscope Camera System mounted on a Type 545B Oscilloscope with a Type 1A1 vertical plug-in unit.

Voltages and waveforms on the schematics (shown in blue) are not absolute and may vary between instruments. Any apparent difference between voltage levels measured and those shown in the waveforms may be due to circuit loading of the measuring device.

The waveforms were obtained with the controls of the analyzer, plug-in oscilloscope and test oscilloscope as noted on each individual diagram.

## MANUAL CHANGE INFORMATION

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

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

WAVEFORMS and VOLTAGES were obtained with the conditions described on the block diagram and as follows:

| Type 3L5 and Time Base Unit | |
|---|---|
| CENTER FREQUENCY-Hz | 500 k |
| VERTICAL DISPLAY | LIN |
| DISPERSION | |
| Hz/DIV | 100 K |
| VARIABLE | CAL |
| VOLTS/DIV | .005 |
| V/DIV : 100 | Pushed in |
| Time/Div | 20 ms |
| **Test Oscilloscope** | |
| Triggering | External from the Time Base + Gate Out |

REFERENCE DIAGRAMS

- (1) ATTENUATORS & INPUT CIRCUITS
- (3) CENTER FREQUENCY SWITCHING
- (4) DISP. WARNING LIGHT SWITCHING
- (6) OUTPUT DRIVER
- (9) POWER DISTRIBUTION

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

TYPE 3L5 SPECTRUM ANALYZER

SWEPT FREQUENCY GENERATOR (2)
(S/N 160 - UP)

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