P6231 PROBE

Please Check for CHANGE INFORMATION at the Rear of This Manual

First Printing MAY 1986
Revised SEP 1987
Copyright © 1986 Tektronix, Inc. All rights reserved. Contents of this publication may not be reproduced in any form without the written permission of Tektronix, Inc.

Products of Tektronix, Inc. and its subsidiaries are covered by U.S. and foreign patents and/or pending patents.

TEKTRONIX, TEK, SCOPE-MOBILE, and ™ are registered trademarks of Tektronix, Inc. TELEQUIPMENT is a registered trademark of Tektronix U.K. Limited.

Printed in U.S.A. Specification and price change privileges are reserved.
TABLE OF CONTENTS

LIST OF ILLUSTRATIONS .................................................. iii
LIST OF TABLES .............................................................. v
OPERATORS SAFETY SUMMARY ........................................ vi
SERVICING SAFETY SUMMARY ........................................ vii

SECTION 1 SPECIFICATION
DESCRIPTION ................................................................. 1-1
ACCESSORIES ............................................................. 1-1
PERFORMANCE CONDITIONS ........................................... 1-2

SECTION 2 OPERATING INSTRUCTIONS
INTRODUCTION .............................................................. 2-1
OPERATING CONSIDERATIONS .......................................... 2-1
  Probe Handling ......................................................... 2-1
  Input Dynamic Range ................................................. 2-1
  Probe Grounding ...................................................... 2-2
CONTROLS AND CONNECTORS ........................................... 2-4
PROBE ACCESSORIES ................................................... 2-4
OPERATION ................................................................. 2-7

SECTION 3 PERFORMANCE CHECK
PURPOSE ........................................................................ 3-1
TEST EQUIPMENT REQUIRED .......................................... 3-1
LIMITS AND TOLERANCES ............................................. 3-1
PREPARATION ............................................................... 3-1
PROCEDURE STEPS ........................................................ 3-3
DC Offset Check ........................................................... 3-3
Bandwidth/Rise Time
High-Frequency Aberrations Check ................................. 3-5

WARNING
The following servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing other than that contained in operating instructions unless you are qualified to do so.
# TABLE OF CONTENTS (cont)

## SECTION 4 ADJUSTMENT PROCEDURE
- PURPOSE ...................................................... 4-1
- TEST EQUIPMENT REQUIRED ......................... 4-1
- ADJUSTMENT SEQUENCE .................................. 4-1
- ADJUSTMENT LOCATIONS .................................... 4-1
- PREPARATION .................................................. 4-2
- PROCEDURE STEPS .......................................... 4-4
  - Check/Adjust Offset Null ............................. 4-4
  - Check/Adjust Attenuation Accuracy and Mid-Frequency Response .......... 4-4

## SECTION 5 THEORY OF OPERATION
- INTRODUCTION ............................................... 5-1
- GENERAL CIRCUIT DESCRIPTION ......................... 5-1
- DETAILED CIRCUIT DESCRIPTION ......................... 5-1

## SECTION 6 MAINTENANCE
- INTRODUCTION ............................................... 6-1
- STATIC-SENSITIVE COMPONENTS ......................... 6-1
- PREVENTIVE MAINTENANCE ................................ 6-3
  - Cleaning ............................................... 6-3
  - Visual Inspection ...................................... 6-4
  - Semiconductor Checks ................................ 6-4

## SECTION 7 REPLACEABLE PARTS
- DIAGRAMS
- REPLACEABLE ELECTRICAL PARTS
- REPLACEABLE MECHANICAL PARTS
- OPTIONAL ACCESSORIES

TROUBLESHOOTING ........................................... 6-4
  - Troubleshooting Techniques ............................ 6-9
CORRECTIVE MAINTENANCE ................................. 6-10
  - Maintenance Precautions ............................... 6-10
  - Obtaining Replacement Parts ......................... 6-10
PROBE DISASSEMBLY ........................................ 6-11
  - Control Box Disassembly .............................. 6-11
  - Cable Assembly Replacement ........................... 6-12
  - Probe Tip Replacement ................................ 6-13
  - Button Replacement .................................... 6-13
READJUSTMENT AFTER REPAIR ............................. 6-13
INSTRUMENT REPACKING ..................................... 6-13

P6231
# LIST OF ILLUSTRATIONS

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The P6231 Probe</td>
<td>viii</td>
</tr>
<tr>
<td>1-1 Typical input impedance versus frequency</td>
<td>1-6</td>
</tr>
<tr>
<td>2-1 Damaging effects of ground-lead inductance</td>
<td>2-2</td>
</tr>
<tr>
<td>2-2 Reducing the effects of ground-lead inductance</td>
<td>2-3</td>
</tr>
<tr>
<td>2-3 Controls, connectors, and probe accessories</td>
<td>2-5</td>
</tr>
<tr>
<td>2-4 Example of reduced loading</td>
<td>2-7</td>
</tr>
</tbody>
</table>
## LIST OF ILLUSTRATIONS (cont)

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-1</td>
<td>3-4</td>
<td>Offset-check setup</td>
</tr>
<tr>
<td>3-2</td>
<td>3-4</td>
<td>High-frequency check setup</td>
</tr>
<tr>
<td>4-1</td>
<td>4-5</td>
<td>P6231 adjustment locations</td>
</tr>
<tr>
<td>5-1</td>
<td>5-2</td>
<td>Functional block diagram</td>
</tr>
<tr>
<td>6-1</td>
<td>6-12</td>
<td>Disassembly of control box</td>
</tr>
<tr>
<td>7-1</td>
<td></td>
<td>Main circuit-board layout</td>
</tr>
<tr>
<td>7-2</td>
<td></td>
<td>Flexible circuit-board layout</td>
</tr>
<tr>
<td>7-2</td>
<td></td>
<td>Component layout for trouble shooting</td>
</tr>
</tbody>
</table>
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>Electrical Characteristics</td>
</tr>
<tr>
<td>1-2</td>
<td>Environmental Characteristics</td>
</tr>
<tr>
<td>1-3</td>
<td>Physical Characteristics</td>
</tr>
<tr>
<td>2-1</td>
<td>Typical Performance Effects of Grounding Configurations</td>
</tr>
<tr>
<td>3-1</td>
<td>Test Equipment Required</td>
</tr>
<tr>
<td>4-1</td>
<td>Test Equipment Required</td>
</tr>
<tr>
<td>6-1</td>
<td>Relative Susceptibility To Static Discharge Damage</td>
</tr>
<tr>
<td>6-2</td>
<td>Troubleshooting Equipment</td>
</tr>
<tr>
<td>6-3</td>
<td>Fault Indication and Probable Cause</td>
</tr>
</tbody>
</table>
OPERATORS SAFETY SUMMARY

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

Terms In This Manual

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

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

Do Not Operate In Explosive Atmospheres

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

Do Not Remove Covers

To avoid personal injury, do not remove the product covers. Do not operate the product without the covers properly installed.
SERVICE SAFETY SUMMARY
FOR QUALIFIED SERVICE PERSONNEL ONLY
Refer also to the preceding Operators Safety Summary.

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

Use Care When Servicing With Power On
To avoid personal injury, do not touch exposed connections and components while power is on.
The P6231 probe.
SPECIFICATION

DESCRIPTION

The TEKTRONIX P6231 is a low-impedance, subminiature, 10X active probe with identification capability. The probe is designed for use with 11000 Series oscilloscopes and is equipped with the new TEKPROBE™ interface which draws power from the host instrument and provides data communication between the oscilloscope and the probe. Data contained within the probe informs the instrument of the probe’s attenuation, model number and identification number, and causes the input to automatically terminate with 50 ohms. The ID button on the probe head activates the ID function in the instrument. The ID signal can also set an SRQ (Service Request) flag on an IEEE-488 bus if the instrument is programmed to do so. The P6231 meets the requirements of UL 1244.

The P6231 offers a variable offset voltage at the probe tip to reduce loading effects. The offset is controlled through the TEKPROBE™ interface by the host instrument. The voltage available at the probe tip spans the range from −5V to +5V, allowing the probe to minimize loading effects on most logic families in use today.

The P6231 is available with a 1.5-meter signal cable. No power cable is necessary, as power is drawn from the host instrument plug-in through the TEKPROBE™ interface.

The subminiature probe head of the P6231 is fully compatible with the Tektronix family of subminiature probe accessories.

ACCESSORIES

The P6231 is shipped with the following standard accessories:

1 Instruction manual
1 Accessory Pouch
1 Hook tip
2 Circuit-board-to-probe-tip connectors
1 Ground lead with microhook/alligator clip
1 Low inductance ground-lead assembly
1 A packet of assorted cable-marker sets.

Use of these accessories is described in the “Operating Instructions” section of this manual. Part numbers and optional accessories are listed in the “Replaceable Parts List” (Section 7).
PERFORMANCE CONDITIONS

The electrical characteristics listed in Table 1-1 apply when a calibrated probe is used with a calibrated oscilloscope system operating within the environmental conditions stated in Table 1-2.

Items listed in the "Performance Requirement" column are verifiable qualitative or quantitative limits. Items listed in the "Supplemental Information" column are not verified in the "Performance Check Procedure" (Section 3); they are either explanatory notes, calibration setup descriptions, performance characteristics for which no absolute limits are specified, or characteristics that are impractical to check.

The probe's physical characteristics are listed in Table 1-3.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Performance Requirement</th>
<th>Supplemental Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attenuation (system)</td>
<td>10X ±1% at dc.</td>
<td>Probe attached to 11000 series plug-in.</td>
</tr>
<tr>
<td>Input Resistance (system)</td>
<td>450Ω ±1% at dc.a</td>
<td>Probe attached to 11000 series plug-in.</td>
</tr>
<tr>
<td>Input Capacitance (1 kHz to 1.5 GHz)</td>
<td>Less than 1.6 pF.a</td>
<td>Typically 1.3 pF. See Figure 1-1 for a graph of input impedance versus frequency.</td>
</tr>
</tbody>
</table>

Table 1-1

Electrical Characteristics

Specification — P6231

REV AUG 1986
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Performance Requirement</th>
<th>Supplemental Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bandwidth (−3 dB) (Probe Only)</td>
<td>DC to at least 1.5 GHz.</td>
<td>Calculated from risetime: BW = 0.35 ÷ risetime.</td>
</tr>
<tr>
<td>Risetime (Probe Only)</td>
<td>Less than 230 ps.</td>
<td>Test system must have a risetime of less than 100 ps.</td>
</tr>
<tr>
<td>Aberrations (Probe Only)</td>
<td>&lt; +4%, −9% for the first 1 ns (referenced from 1 ns); ±3% thereafter.</td>
<td>In addition to system aberrations.</td>
</tr>
<tr>
<td>Signal Delay</td>
<td>8.70 ns ± 100 ps.ª</td>
<td>Probe tip to output BNC.</td>
</tr>
<tr>
<td>Input Dynamic Range</td>
<td>−5 V ≤ (V_{signal} + V_{offset}) ≤ +5 V.</td>
<td></td>
</tr>
<tr>
<td>Offset Null</td>
<td>Less than ±10 mV.</td>
<td></td>
</tr>
<tr>
<td>DC Offset Range</td>
<td>0 to at least +5 V, ±2% and −5 V, ±2%.</td>
<td>Measured from probe tip to ground with a high impedance (≥ 50 kΩ/V) voltmeter.</td>
</tr>
<tr>
<td>DC Thermal Drift</td>
<td>Less than 10 mV/°C.</td>
<td>Equivalent input offset.</td>
</tr>
</tbody>
</table>

ªPerformance requirement not checked in manual.
### Table 1-1 (cont)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Performance Requirement</th>
<th>Supplemental Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Load Requirement</td>
<td>50Ω ± 0.5%</td>
<td></td>
</tr>
<tr>
<td>Maximum Nondestructive</td>
<td>10 Vdc continuous&lt;sup&gt;a&lt;/sup&gt;</td>
<td>30 V (dc + peak ac) for 1 sec.</td>
</tr>
<tr>
<td>Input Voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Supply Requirements</td>
<td>Power is drawn from the&lt;sup&gt;a&lt;/sup&gt; host instrument.</td>
<td></td>
</tr>
<tr>
<td>ID Button Life</td>
<td>&gt;50 Kcycles&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Performance Requirement not checked in manual.
**Table 1-2**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Range (Operating)</td>
<td>0°C to +50°C ( +32°F to +122°F).</td>
</tr>
<tr>
<td>Temperature Range (Nonoperating)</td>
<td>−55°C to +75°C (−67°F to +167°F).</td>
</tr>
<tr>
<td>Humidity</td>
<td>Five cycles (120 hr.) at 90% to 95% relative humidity at 30°C to 60°C.</td>
</tr>
<tr>
<td>Altitude (Operating)</td>
<td>To 4,600 m (15,000 ft).</td>
</tr>
<tr>
<td>Transportation</td>
<td>Qualifies under National Safe Transit Association’s Pre-shipment Test Procedures; 1A-B-1.</td>
</tr>
</tbody>
</table>

**Table 1-3**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Weight (includes accessories)</td>
<td>354 g (12.5 oz).</td>
</tr>
<tr>
<td>Signal Cable Length</td>
<td>1.5 m (60 in).</td>
</tr>
</tbody>
</table>
Figure 1-1. Typical input impedance versus frequency.
OPERATING INSTRUCTIONS

This section of the manual is intended to familiarize the operator with the use of the P6231 Probe. Included are operating considerations, descriptions of the controls and connectors, instructions for the use of the accessories, and a description of the use and operation of the probe.

NOTE

The P6231 is shipped along with its standard accessories. At installation, save the shipping and packaging materials for reuse should reshipment become necessary. Refer to “Maintenance” (Section 6) for further information.

OPERATING CONSIDERATIONS

Probe Handling

The P6231's subminiature body has been designed for ease of use when probing small circuitry. Both the probe itself and its accessories should be handled carefully at all times. Avoid dropping the probe body, since damage to its tip may result. Exercise care to prevent crushing the cable or placing excessive strain on it by pulling.

Input Dynamic Range

The input dynamic range of the P6231 is limited by the ability of the internal amplifier to drive the 50Ω termination. This limitation exists whether the input signal originates at the probe tip (test signal) or as internal offset voltage. Therefore, the limitation on the signal that can be applied to the probe tip is dependent on the amount of offset voltage being used. To maintain signal fidelity, the test signal should not exceed the limits imposed by the following formula:

\[-5.0 \, V \leq (V_{\text{signal}} + V_{\text{offset voltage}}) \leq +5.0 \, V\]
Probe Grounding

Inductance caused by either a long signal lead or ground lead will form a series-resonant circuit that can distort the true waveform or degrade the bandwidth. Ground lead and signal input connections should be kept as short as possible to maintain the best waveform fidelity. (Refer to Figures 2-1 and 2-2.)

Ground lead inductance can significantly reduce the performance of a probe. As shown in the model above, the ground lead inserts a series inductance into the signal path forming a series-resonant circuit between $C_{in}$ of the probe and ground lead $L$, with only $R_{source}$ as damping. This forms a resonant circuit with an $f_0 = 1 / (2\pi \sqrt{LC})$. A six-inch ground lead has $\sim 150$ nH of self inductance causing an $f_0$ of 325 MHz, which is within the frequency response of the instrument. This greatly degrades risetime, bandwidth, and transient accuracy (see illustration). For best results, make sure that ground lead inductance is minimized. Three methods for doing so are described on the following page.

Figure 2-1. Damaging effects of ground-lead inductance.

6027-2
ECB to Probe-Tip Adapters provide high-quality connection test points when installed on circuit boards. The ribbed-plastic tip cover on the probe must be removed. The probe will then plug into the test point directly. Adapters are available in bags of 100 (see "Replaceable Parts.")

The low-inductance lead provided with all Tek subminiature probes allows for a substantial reduction of ground-lead L (~32 nH instead of 150 nH). To use, unscrew the ribbed-tip cover and slide off the ground collar with ground lead. Slip on the low-inductance lead ground collar (1) and reinstall the ribbed-tip cover. Install the low-inductance lead (2) from the accessory pack.

The Tektronix Klipkit (optional, see "Replaceable Parts.") provides a hands-off connection of signal and ground to an IC (up to 16 pins). Klipkit ground is acquired by inserting a connecting pin (included) into the Klipkit at the proper pin. The probe body will then make ground connection when inserted into the other contact locations.

Figure 2-2. Reducing the damaging effects of ground-lead inductance.
DESCRIPTION OF CONTROLS AND CONNECTORS

The following information will familiarize the operator with the location and function of the external controls and connections of the P6231. Please refer to Figure 2-3.

1. **TEKPROBE™ Interface** - Provides connections for signal, power, and data communication between the probe and the host instrument.

2. **BNC Locking Ring** - Locks the probe onto the host instrument. To install, first check that the locking ring is fully counter-clockwise as viewed from the rear of the compensation box. Insert the probe onto the instrument so that the flipper slips into the notch provided for it on the front panel. To lock the probe onto the instrument, rotate the locking ring clockwise until the probe is secured to the instrument.

3. **ID Button** - Activates the ID function in the host instrument when pushed. Pressing the ID button can also execute a sequential step through a programmed test routine, or generate status flags on an IEEE-488 bus if the oscilloscope is programmed to do so.

4. **Probe Tip** - Used to acquire the signal from the circuit under test.

5. **Ground Collar with Lead** - Can be connected to the alligator clip, the micro-hook, or directly onto a square-pin ground on a circuit board.

6. **Low Inductance Ground Lead Assembly** - Provides the lowest-inductance ground connection for best probe performance.

PROBE ACCESSORIES

Both standard and optional accessories for the P6231 are listed in the “Replaceable Parts List” near the back of this manual. Standard accessories are supplied to aid in connecting the probe to circuitry under test and to protect the probe against damage. These accessories are described in the following paragraphs and are illustrated in Figure 2-3.
Figure 2-3. Controls, connectors, and probe accessories.
Table 2-1

Typical Performance Effects of Grounding Configurations

<table>
<thead>
<tr>
<th>Grounding Method</th>
<th>Risetime</th>
<th>Bandwidth (calculated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probe tip-to-GR adapter.</td>
<td>230 ps.</td>
<td>1.5 GHz.</td>
</tr>
<tr>
<td>Low-inductance lead.</td>
<td>440 ps.</td>
<td>800 MHz.</td>
</tr>
<tr>
<td>6.5-inch lead.</td>
<td>1.0 ns.</td>
<td>350 MHz.</td>
</tr>
<tr>
<td>No ground lead.</td>
<td>16 ns.</td>
<td>22 MHz.</td>
</tr>
</tbody>
</table>

Ground Leads

The P6231 Probe is supplied with two ground-lead systems: a ground collar with integral lead and a low-inductance ground collar/lead. The collar with integral lead features a 6.5-inch lead length which is attachable to an alligator clip, a micro-hook, or directly to a square-pin connector on the circuit board. Refer to the information on ground-lead inductance in Figures 2-1 and 2-2 to assist you in making the best selection of a ground-lead system.

Cable Markers

Cable markers are provided in several different colors to help identify specific probes when using multichannel oscilloscopes.

Circuit-Board-to-Probe-Tip Connectors

Two circuit-board-to-probe-tip connectors are provided for making permanent probe test points on circuit boards. These connectors provide extremely short signal and ground paths to minimize ringing. Before inserting the probe tip into a connector, remove both the light-grey probe-body shell and the grounding collar from the tip.

Hook Tip

The hook tip provides the means for making a hands-free connection to a test point or component lead. To install the hook tip, just slide the hook tip onto the probe.

Carrying Pouch

The carrying pouch (not shown) provides a convenient means to store and protect the P6231, its accessories, and this manual when they are not in use.
OPERATION

The P6231 is a passive, 500-ohm divider probe with the additional feature of a variable offset available at the probe tip.

What is the value of this offset? Imagine a source which consists of an AC signal riding on a DC level. Imagine also that the source impedance is high enough that its operation (specifically, its bias), is disrupted by the addition of a 500 ohm shunt to ground (similar to a traditional 500-ohm probe).

![Diagram of circuit](image)

**Figure 2-4. Example of reduced loading.**

Now, add the feature of offset bias, with the P6231 attached to the circuit and with its offset adjusted to equal the DC component of the signal being measured. The DC component of probe loading is now eliminated, and circuit bias is restored.

In Figure 2-4, there is a source having both DC and AC components. From the voltage divider of \( R_S \) and \( R_L \), there will be a DC voltage at that test point. If the P6231 offset is adjusted so that it is equal to that DC voltage, then there is effectively no DC voltage across the 450-ohm probe resistor (and no current flow), which implies an infinite impedance (for that voltage only).

To use the offset feature, first measure or calculate the offset potential present at the test point. Call up the menu controlling probe functions on the 11000 Series oscilloscope, Select Probe Offset Voltage, then rotate the front-panel-control knob until the correct voltage is displayed on screen. Select that voltage, then exit the menu. That voltage is now output to the probe tip. Confirmation of this voltage can be made by checking the voltage to ground at the probe tip with a voltmeter or other high-impedance measurement device.
PERFORMANCE CHECK PROCEDURE

PURPOSE

The "Performance Check Procedure" is used to verify the probe's Performance Requirements as listed in "Specification" (Section 1) and to determine the need for readjustment. This procedure may also be used both as an acceptance check and as a test of the probe after repair.

This section contains only the procedures for checking the P6231's dc offset range and high-frequency characteristics. The check procedure for the probe's attenuation accuracy has been combined with the probe's adjustment procedures due to the similarity of their setups. This check/adjustment may be found in "Adjustment Procedures" (Section 4).

TEST EQUIPMENT REQUIRED

The test equipment listed in Table 3-1 is a complete list of equipment required to accomplish the "Performance Check Procedure." Test equipment specifications described in Table 3-1 are the minimum necessary to provide accurate results; therefore, equipment used must meet or exceed the listed specifications. Detailed operating instructions for test equipment are not contained in this procedure. Should additional operating information be needed, refer to the appropriate test-equipment instruction manual.

LIMITS AND TOLERANCES

The limits and tolerances given in this procedure are for the P6231 under test only. Test-equipment error is not included except as noted.

PREPARATION

Before proceeding with the check, allow sufficient warm-up time for test equipment to stabilize (typically 20 minutes).
<table>
<thead>
<tr>
<th>Item Number and Description</th>
<th>Minimum Specification</th>
<th>Purpose</th>
<th>Example of Suitable Test Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Oscilloscope</td>
<td>Bandwidth: dc to about 15 MHz. Vertical deflection factor: 5 mV to 1 V.</td>
<td>Offset range check.</td>
<td>TEKTRONIX 11000 Series with 11A32 plug-in.</td>
</tr>
<tr>
<td>2. Digital Multimeter</td>
<td>DC volts accuracy: 0.1%</td>
<td>Offset range check.</td>
<td>TEKTRONIX DM 502A.</td>
</tr>
<tr>
<td>3. DC Voltage Source</td>
<td>Output: + and - 5 V.</td>
<td>Offset range check.</td>
<td>TEKTRONIX PS 503A.</td>
</tr>
<tr>
<td>5. Sampling Head</td>
<td>Bandwidth: dc to 4.6 GHz.</td>
<td>HF checks.</td>
<td>TEKTRONIX S-6.</td>
</tr>
</tbody>
</table>
Table 3-1 (cont)

Test Equipment Required

<table>
<thead>
<tr>
<th>Item Number and Description</th>
<th>Minimum Specification</th>
<th>Purpose</th>
<th>Example of Suitable Test Equipment</th>
</tr>
</thead>
</table>

PROCEDURE STEPS

1. DC Offset Check

Equipment Required (see Table 3-1):

Oscilloscope (Item 1)
Digital Multimeter (Item 2)
DC Voltage Source (Item 3)

a. Connect the probe to an 11A32 plug-in in an 11000 Series oscilloscope mainframe.

d. Set the oscilloscope input coupling to DC.

c. Vertically position the trace to the center horizontal graticule line.

b. Set the oscilloscope controls as follows:

Volts/Division 2 V
Input Coupling GND
Time/Division 1 ms
Trigger Source Internal
Trigger Mode Auto
Figure 3-1. Offset check setup.

Figure 3-2. High-frequency check setup.

Performance Check Procedure – P6231

REV AUG 1986
e. Touch the probe input to a convenient ground point on the test oscilloscope.

f. CHECK — That the OFFSET VOLTAGE control on the oscilloscope is able to vertically position the trace over a +5.0 V to -5.0 V range.

g. Remove the probe input from the ground point. Connect the probe ground, via a probe ground lead, to the common input of the multimeter. Touch the probe input to the + input of the multimeter.

h. Set multimeter controls for DC volts, 20 V scale.

i. CHECK — That the OFFSET VOLTAGE control on the oscilloscope is able to vary the voltage at the probe tip over a +5.0 V and -5.0 V range.

j. Remove the probe from the multimeter.

k. Using the multimeter to confirm, adjust the variable dc voltage source (PS503) to +5.0 V.

l. Connect the probe ground, via a probe ground lead, to the voltage source (PS503) common output. Touch the the probe input to the + output (refer to Figure 3-1).

m. CHECK — That the OFFSET VOLTAGE control on the oscilloscope is able to set the oscilloscope trace to 0.0 V.

n. Repeat steps l and m with the voltage source set to -5.0 V and the probe connected to the — output.

o. Disconnect the test setup.

2. Bandwidth/Risetime/High-Frequency Aberrations Check

Equipment Required (see Table 3-1):

- Oscilloscope (Item 4)
- Sampling Head (Item 5)
- Pulse Generator Head (Item 6)
- Termination Adapter (Item 7)
- Adapter (Item 8)
- Adapter (Item 9)
NOTE

The risetime and aberrations specifications of the pulse generator/sampling oscilloscope system are required to complete this check (see step g). These may be found in the "Specifications" section of the appropriate instrument manual or measured by performing the procedure given below while substituting a 50-Ω cable for the P6231 and increasing the Volts/Division setting by a factor of 10.

e. Measure the risetime of the displayed waveform.

f. Calculate the probe risetime using the following formula:

\[
\text{Probe Risetime} = \sqrt{(\text{Measured risetime})^2 - (\text{Sampling system risetime})^2}
\]

g. CHECK — The probe rise time calculated in part f should be less than 230 ps. This indicates a bandwidth of at least 1.5 GHz as calculated from the formula:

\[
\text{Bandwidth} = 0.35/\text{Rise Time}
\]

h. Set the oscilloscope/sampler Time/Division control to 500 ps.

i. CHECK — The high-frequency aberrations do not exceed \(+4\%\), \(-9\%\), for the first 1 ns (referenced from 1 ns); \(\pm 3\%\) thereafter.

j. Disconnect the test setup.
ADJUSTMENT PROCEDURE

PURPOSE

This section contains the information necessary to perform the attenuation, offset null, and mid-frequency adjustments for the P6231 Probe. The adjustment procedures are not intended to be troubleshooting guides. However, any deficiency found during performance of each adjustment step should be corrected before continuing. Tektronix Field Service Centers and the Factory Service Center provide instrument repair and adjustment service. Refer to "Maintenance" in Section 6 for further repair information.

TEST EQUIPMENT REQUIRED

The test equipment listed in Table 4-1 is a complete list of equipment required to accomplish the "Adjustment Procedures." Test equipment specifications described in Table 4-1 are the minimum necessary to provide accurate results; therefore, equipment used must meet or exceed the listed specifications. Detailed operating instructions for test equipment are not contained in this procedure. Should additional operating information be needed, refer to the appropriate test equipment instruction manual.

ADJUSTMENT SEQUENCE

Because of adjustment interaction, the adjustment steps must be performed in the order given.

ADJUSTMENT LOCATIONS

Adjustment locations are shown in Figure 4-1. Only the adjustable components are illustrated in this figure.
PREPARATION

Before proceeding with each adjustment step, allow sufficient warm-up time for test equipment to stabilize (typically 20 minutes).

It is necessary to remove the top half of the Control Box cover to perform the Adjustment Procedure. Refer to the removal instructions in "Maintenance" (Section 6).

Table 4-1

<table>
<thead>
<tr>
<th>Item Number and Description</th>
<th>Minimum Specification</th>
<th>Purpose</th>
<th>Example of Suitable Test Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Real Time Oscilloscope</td>
<td>Bandwidth: dc to at least 100 MHz. Vertical deflection factor: 5 mV to 1 V. Two vertical channels.</td>
<td>Offset null, attenuation, and mid-frequency adjustments</td>
<td>TEKTRONIX 11000 Series with 11A32 plug-in.</td>
</tr>
<tr>
<td>2. Calibration Generator</td>
<td>Pulse rise time: 1 ns or less. Amplitude: 0.5 V or more into 50Ω. Repetition rate: 1 kHz to 100 kHz, Accuracy: ± 0.25%.</td>
<td>Attenuation and mid-frequency adjustments</td>
<td>TEKTRONIX PG 506.a</td>
</tr>
<tr>
<td>3. Precision Coaxial Cable</td>
<td>Impedance: 50Ω. Length: 36 in. Connectors: BNC.</td>
<td>Attenuation and mid-frequency adjustments</td>
<td>Tektronix Part Number 012-0482-00.</td>
</tr>
</tbody>
</table>

aRequires a TM 500-Series power-module mainframe.
<table>
<thead>
<tr>
<th>Item Number and Description</th>
<th>Minimum Specification</th>
<th>Purpose</th>
<th>Example of Suitable Test Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. BNC T</td>
<td>Connectors: BNC.</td>
<td>Attenuation and mid-frequency adjustments.</td>
<td>Tektronix Part Number 103-0030-00.</td>
</tr>
</tbody>
</table>
PROCEDURE STEPS

1. Check/Adjust Offset Null

   Equipment Required (see Table 4-1):

   Oscilloscope (Item 1)
   Alignment Tool (Item 7)

   a. Connect the probe output to the test oscilloscope vertical input. Leave the probe tip free of all connections.

   b. Set test oscilloscope controls as follows:

      | Volts/Division | 100 mV |
      | Time/Division | 1 ms |
      | Input Coupling | DC |
      | Bandwidth | Full Bandwidth |

   c. Center the trace on the screen.

   d. CHECK — That the oscilloscope trace does not shift more than 1/2 of a minor division (10 mV referenced to the probe tip), while rotating the OFFSET VOLTAGE control on the oscilloscope from one extreme to the other.

   If the trace shift is within tolerance, proceed with the next adjustment. If the trace shift is excessive, proceed with part e.

   e. ADJUST — R38 (see Figure 4-1) for minimum trace shift while rotating the OFFSET VOLTAGE on the oscilloscope control back and forth.

2. Check/Adjust Attenuation Accuracy and Mid-Frequency Response

   Equipment Required (see Table 4-1):

   Oscilloscope (Item 1)
   Calibration Generator (Item 2)
   Coaxial Cable (Item 3)
   Adapter (Item 4)
   Termination (Item 5)
   BNC T (Item 6)
   Alignment Tool (Item 7)
a. Set test oscilloscope controls as follows:

- Ch 1 Volts/Division: 100 mV
- Ch 2 Volts/Division: 10 mV
- Display Mode: Alternate
- Trigger Source: Mode
- Time/DIVision: 1 ms
- Input Coupling: DC
- Bandwidth: Full Bandwidth

b. Set the calibration generator controls as follows:

- Amplitude: 0.5 V
- Period: 1 ms
- Mode: Standard Amplitude

c. Connect the Amplitude Output of the calibration generator to the channel 1 vertical input via the 50-Ω cable. (Do not use the 50-Ω termination).

d. Set the oscilloscope triggering controls for a stable display and center the display on the screen.

e. Adjust the channel 1 gain control for an exact 5-division display.

f. Move the 50-Ω cable from the channel 1 vertical input to the channel 2 vertical input. (Do not use the 50-Ω termination).

g. Change the amplitude of the calibration generator to 50 mV.
h. Adjust the channel 2 gain control for an exact 5-division display.

i. Remove the 50-Ω cable from the test setup. Install the P6231 on the channel 2 vertical input and set the Channel 2 input to 50-Ω terminated.

j. Connect one end of the 50-Ω cable to the positive-going fast-rise output of the calibration generator. Connect the other end of the cable to one branch of the BNC T connector. Install the subminiature probe tip-to-BNC adapter on the other branch of the BNC T. Install the center leg of the BNC T on the channel 1 vertical input.

k. Change the calibrator mode to Fast Rise.

l. Adjust the calibrator pulse amplitude for a 5-division display.

m. Center the two traces on the screen.

n. CHECK — The amplitude of the channel 2 trace should be within 3% (0.15 division) of the amplitude of the channel 1 trace. The front corner aberrations of the channel 2 trace should also match those of the channel 1 trace within 3%.

If the amplitude and front corner aberrations are within tolerance, disconnect the test setup. If they are not, proceed with step o.

o. Set — The calibration generator to 100 kHz rep rate. Adjust C52 for the fastest response.

p. SET — The calibration generator to 1 kHz rep rate and adjust R56 and R34. The responses of the two channels should match within ±3%.

q. Disconnect the test setup.
THEORY OF OPERATION

INTRODUCTION

This section contains a functional description of the circuitry used in the P6231 Probe. The schematic diagram in "Replaceable Parts" (Section 7 of this manual) may be useful when reading the detailed circuit description. A functional block diagram is also provided (Figure 5-1).

GENERAL CIRCUIT DESCRIPTION

Figure 5-1 is a functional block diagram of the P6231. The P6231 divides the signal into two separate signal paths. The high-frequency path consists of the tip assembly, the cable assembly, R62, C32, and the 50-Ω termination. The probe tip assembly and the termination resistor form a voltage divider as in a conventional 50-Ω passive probe. The dc-to-mid-frequency path consists of the tip assembly, the cable assembly, R62, R54, R56, inverting amplifier U30, differential amplifier U18, R34, and R24. The dc-to-mid-frequency path provides the input bias/offset voltage function.

DETAILED CIRCUIT DESCRIPTION

Operational amplifier U30, R1, R62, R54 and R56, and R78 and R64 form an inverting amplifier with an adjustable bias provided at the amplifier + input by U10. In the dc and low-frequency range, the node at the junction of R56, R76, and R64 is the virtual ground or null point for the inverting amplifier. At dc, the op amp will force the voltage at the null point to equal the adjustable bias voltage applied to the + input (pin 3 of U30). In the mid-frequency-to-high-frequency range, the node at the − input (pin 2 of U30) is an ac ground point.

One half of U10 is low-pass filter/gain stage which removes any noise present on the offset line and applies a gain of 5X to the ± 1 V available from the instrument to develop ± 5 V of offset at the probe tip. The other half of U10 is unused.

R78, R64, and C66 form a phase-lead network which forces op amp U30 to compensate for the phase lag of op amp U18. CR76 is a clamping diode which protects op amp U30 from excessive probe input voltages (such as electrostatic discharges).
U18, R68, R58, R28 and R38, and R26 form a differential amplifier. The differential amplifier subtracts the input bias voltage at pin 3 of U18 from the output of U18 (pin 6), and re-inverts the dc-to-mid-frequency signal. R24 and R34 and the 50-Ω termination form a voltage divider for the output of U18.

U1010 on the flexible circuit board is a factory programmed ROM that stores such data as probe model, identification number, and special conditions required for the probe such as termination, units displayed on screen, or attenuation factor. This data is relayed to the scope on power-up or in response to a query by the host instrument.

![Functional block diagram](6027-10)

Figure 5-1. Functional block diagram.
INTRODUCTION

This section contains information for performing preventive maintenance, troubleshooting, and corrective maintenance on the P6231 Probe.

WARNING

The following service instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any probe maintenance while the probe is connected to a signal source.

STATIC-SENSITIVE COMPONENTS

CAUTION

Static discharge can damage any semiconductor component in this probe.

This probe contains electrical components that are susceptible to damage from static discharge. See Table 6-1 for relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

Observe the following standard precautions to avoid damage:

1. Minimize handling of static-sensitive components.

2. Transport and store static-sensitive components or assemblies in their original containers, on a metal rail, or on conductive foam. Label any package that contains static-sensitive assemblies or components.

3. Discharge the static electricity from your body by wearing a wrist strap while handling these components. Servicing static-sensitive assemblies or components should be performed only at a static-free work station by qualified service personnel.
### Table 6-1

<table>
<thead>
<tr>
<th>Semiconductor Classes</th>
<th>Approximate Susceptibility Level^a</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOS or CMOS (most sensitive)</td>
<td>100-500 V.</td>
</tr>
<tr>
<td>ECL</td>
<td>200-500 V.</td>
</tr>
<tr>
<td>Schottky signal diodes</td>
<td>250 V.</td>
</tr>
<tr>
<td>Schottky TTL</td>
<td>500 V.</td>
</tr>
<tr>
<td>High-frequency bipolar transistors</td>
<td>400-600 V.</td>
</tr>
<tr>
<td>JFET</td>
<td>600-800 V.</td>
</tr>
<tr>
<td>Linear microcircuits</td>
<td>400-1000 V.</td>
</tr>
<tr>
<td>Low-power Schottky TTL</td>
<td>900 V.</td>
</tr>
<tr>
<td>TTL (least sensitive)</td>
<td>1200 V.</td>
</tr>
</tbody>
</table>

^aVoltage discharged from a 100 pF capacitor through a 100-Ω resistor.

4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.

5. Keep the component leads shorted together, whenever possible, with a shorting wire or conductive foam.

6. Pick up components by the body, never by the leads.

7. Do not slide the components over any surface.

8. Avoid handling components in areas that have a floor or work-surface covering capable of generating a static charge.

9. Use a soldering iron that is connected to earth ground.

10. Use only special antistatic suction-type or antistatic wick-type desoldering tools.
PREVENTIVE MAINTENANCE

Preventive maintenance consists primarily of cleaning and visual inspection. When performed on a regular basis, preventive maintenance can prevent instrument breakdown and may improve instrument reliability. The frequency of maintenance depends on the severity of the environment to which the probe is subjected. A convenient time to perform preventive maintenance is just before performing an Adjustment Procedure.

CLEANING

CAUTION

Avoid the use of chemical cleaning agents which may damage the plastics and circuit board used in the probe. In particular, avoid chemicals which contain benzene, toluene, xylene, acetone, MEK, or similar solvents. For additional information on recommended cleaning agents, consult your Tektronix Service Center or representative.

Exterior

Loose dust accumulated on the outside of the probe can be removed with a soft cloth or a small brush. Dirt which remains can be removed with a soft cloth dampened in a mild detergent and water solution. Do not use abrasive cleaners.

Interior

Cleaning the interior of the probe should not be necessary. Normally, the probe compensation box circuit board will not require cleaning unless a cover has been removed for an extended period of time. The best way to clean the interior is to blow off the accumulated dust with dry, low-velocity air (about 9 lb/sq. in). Remove any dirt which remains with a soft brush or a cloth dampened with a nonresidue-type cleaner, preferably isopropyl alcohol. A cotton-tipped applicator is useful for cleaning in narrow spaces or for cleaning more delicate circuit components.
VISUAL INSPECTION

Occasionally inspect the P6231 for such defects as broken connections, damaged parts, bent leads, and heat-damaged components. Overheating usually indicates other trouble in the probe, therefore, the cause of overheating must be corrected to prevent recurrence of the damage.

SEMICONDUCTOR CHECKS

Periodic checking of semiconductors is not recommended. The best check of semiconductor performance is proper operation of the probe.

TROUBLESHOOTING

The following information is provided to facilitate troubleshooting the P6231. An understanding of circuit operation is often helpful in locating troubles. Refer to "Theory of Operation" (Section 5) for this information.

Table 6-2 lists the equipment useful for troubleshooting the P6231. If the particular items listed are not available, substitutions may be made with similar test equipment which meet or exceed the listed specifications.

Table 6-3 is a listing of possible fault indications and their probable causes.
### Table 6-2

**Troubleshooting Equipment**

<table>
<thead>
<tr>
<th>Description</th>
<th>Minimum Specification</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Real time oscilloscope</td>
<td>Bandwidth: dc to about 15 MHz. Vertical deflection factor: 5 mV to 1 V.</td>
<td>TEKTRONIX 7704A with 7A26 and 7B80 plug-ins.</td>
</tr>
<tr>
<td>2. Digital Multimeter</td>
<td>Voltmeter; 0 to 20 V dc range, 0.15% accuracy. Ohmmeter; 0 to 2 MΩ range.</td>
<td>TEKTRONIX DM 502A.</td>
</tr>
</tbody>
</table>

### Table 6-3

**Fault Indication and Probable Cause**

<table>
<thead>
<tr>
<th>Fault Indication</th>
<th>Probable Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. Input signal exceeds probe dynamic range.</td>
<td>Reduce signal amplitude.</td>
</tr>
<tr>
<td>Fault Indication</td>
<td>Probable Cause</td>
<td>Corrective Action</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>----------------------------------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>DC and mid-frequency attenuation wrong. HF attenuation correct.</td>
<td>Attenuation and mid-frequency adjustments incorrect.</td>
<td>See &quot;Adjustment Procedure.&quot;</td>
</tr>
<tr>
<td>DC and mid-frequency portion of signal missing or severely attenuated.</td>
<td>1. Defective power supply.</td>
<td>Check power-supply fuses in plug-in.</td>
</tr>
<tr>
<td></td>
<td>2. U30 or U18 defective.</td>
<td>Return to service center.</td>
</tr>
<tr>
<td></td>
<td>3. R56 or R34 defective.</td>
<td>Return to service center.</td>
</tr>
<tr>
<td>HF portion of signal missing or severely attenuated. DC and</td>
<td>C32 defective.</td>
<td>Return to service center.</td>
</tr>
<tr>
<td>mid-frequency response correct.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mid-frequency gain out specification.</td>
<td>C52 misadjusted or defective.</td>
<td>See &quot;Adjustment Procedure.&quot; Return to service center if adj. does not correct problem.</td>
</tr>
<tr>
<td>Fault Indication</td>
<td>Probable Cause</td>
<td>Corrective Action</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Rise time out of specification or excessive hf aberrations.</td>
<td>1. Defective probe tip assembly.</td>
<td>Replace probe tip assembly.</td>
</tr>
<tr>
<td></td>
<td>2. R62 defective.</td>
<td>Return to service center.</td>
</tr>
<tr>
<td>No signal or intermittent signal.</td>
<td>1. Broken or unsoldered wire, connection, or component.</td>
<td>Visually check for damage and repair any found.</td>
</tr>
<tr>
<td></td>
<td>2. Defective cable assembly.</td>
<td>Check for shorts or opens and replace if necessary.</td>
</tr>
<tr>
<td></td>
<td>3. Signal path shorted to ground.</td>
<td>Visually check all probe cable connectors and circuit board connectors. Repair or replace if necessary.</td>
</tr>
</tbody>
</table>
Table 6-3 (cont)

Fault Indication and Probable Cause

<table>
<thead>
<tr>
<th>Fault Indication</th>
<th>Probable Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrument does not respond to ID switch</td>
<td>1. Defective ID switch.</td>
<td>Return to service center.</td>
</tr>
<tr>
<td></td>
<td>2. Open Cable.</td>
<td>Replace cable.</td>
</tr>
<tr>
<td></td>
<td>3. Broken pin on TPI conn.</td>
<td>Replace pin.</td>
</tr>
<tr>
<td>Input bias/offset voltage feature does not work or is out of specification.</td>
<td>1. U30 defective.</td>
<td>Return to service center.</td>
</tr>
<tr>
<td></td>
<td>2. U10, R20, R48, R46 defective.</td>
<td>Return to service center.</td>
</tr>
<tr>
<td></td>
<td>3. Power supply is defective or out of specification.</td>
<td>Check power-supply fuses in plugin.</td>
</tr>
<tr>
<td>Oscilloscope does not respond to installed probe.</td>
<td>1. Broken pin on TPI connector.</td>
<td>Replace pin.</td>
</tr>
<tr>
<td></td>
<td>2. ROM damaged.</td>
<td>Return to service center.</td>
</tr>
</tbody>
</table>
**TROUBLESHOOTING TECHNIQUES**

The following techniques are arranged in an order that checks the simple possibilities before proceeding with extensive troubleshooting. The first few checks ensure proper connection, operation, and calibration. If the trouble is not located by these checks, the remaining steps should aid in isolating a defective component. Replace defective components using the "Corrective Maintenance" procedures in this section.

1. **Check Control Settings**

Incorrect control settings can indicate a trouble that does not exist. If there is any question about the correct function or operation of any control, refer to Section 2, "Operating Instructions."

2. **Check Associated Equipment**

Associated equipment at either input or output of the probe may be defective. A signal you expect to see might not exist or might be distorted at the point you are testing. If you are using the probe with an oscilloscope, the vertical amplifier may be defective or the vertical controls may be misadjusted.

3. **Check Calibration**

An out-of-calibration condition of either oscilloscope or probe can cause an apparent error in a measurement.

4. **Make Visual Checks**

Many problems can be located visually. Check for broken wires, damaged connections, or damaged circuit boards. If you discover a heat-damaged component, find the cause of overheating to prevent recurrence of the problem.

5. **Refer to Troubleshooting Chart**

Table 6-3 lists possible malfunctions and their probable causes.

6. **Check Waveforms and Voltages.**

Schematic and component layout diagrams are provided in Section 7.
CORRECTIVE MAINTENANCE

Corrective maintenance consists of replacing a defective component or assembly. Special techniques required to replace components are given here.

MAINTENANCE PRECAUTIONS

To reduce the possibility of personal injury or probe damage, observe the following precautions:

WARNING

To prevent electric shock or shorting of components, do not perform probe maintenance while the probe is connected to a power source.

NOTE

Because the P6231 is constructed with surfacemounted components which are not easily removed or resoldered, repair of components on the circuit boards should be referred to a Tektronix service center.

OBTAINING REPLACEMENT PARTS

Special Parts

Most of the parts and assemblies in this probe are specifically made or selected by Tektronix, Inc. to meet specific performance requirements. Order all parts directly from your local Tektronix Field Office or representative.
Ordering Parts

When ordering and to insure receiving the proper parts or assemblies, include all of the following information with your order:

1. Instrument type (including modification or option numbers).

2. Description of the part (if electrical, include the circuit number).

3. The Tektronix part number.

PROBE DISASSEMBLY

Control Box Disassembly

WARNING

To prevent electric shock or shorting of components, do not perform probe maintenance while the probe is connected to a power source.

The following procedure should be used when replacing assemblies in the Control Box.

Insert tool (Tektronix Part Number 003-1383-00, optional), into the slots near the top of the control box, pressing firmly on both tabs while prying upwards on the box-half parting line to separate the halves.

CAUTION

Failure to hold the cable boot and BNC assemblies in the bottom box half while disassembling may result in damage to the flexible circuit board which resides below the main board and connects it to the BNC assembly. It is suggested that adhesive tape be used to hold the BNC and cable boot assemblies to the bottom box-half while performing inspections.
Cable Assembly Replacement

The probe head and cable is replaceable as a complete assembly. To remove the cable assembly, first follow the steps given above to gain access to the circuit board. Then proceed as follows.

Note the position of the circuit-board aligning spring at the rear of the circuit board. Unsolder the blue wire coming from the cable into the main board. Note that its solder pad is labelled 10. Unsolder the cable center conductor from the circuit board. Remove the tape holding the cable assembly. Gently tilt the back of the main board upwards by lifting the gray plastic cable retainers.

**CAUTION**

Do not tilt the main board further than necessary or attempt to remove it entirely as damage to the flexible board will result.

Carefully unplug the cable assembly from the main board and remove the retainer halves.

Figure 6-1. Disassembly of control box.
Plug the new cable into the main board. Resolder the cable center conductor to the circuit board. Reattach the retainer halves to the cable. Lower this assembly into the lower box half while holding the circuit board alignment spring out of the way with tweezers (one corner at a time). Press the circuit board/cable assembly firmly into the bottom box half. Insert the blue wire into the solder pad marked ID. Resolder. Reinstall the box top half noting that the semicircular cutout with the tab must mate with the BNC end.

Probes Tip Replacement

To remove the probe tip, first unscrew the light gray probe body shell and slide off the grounding collar (refer to Figure 2-2). Then unscrew the probe tip from the cable assembly. The probe tip for the P6231 has small plastic end pieces that are color coded yellow at the tip end and blue at the cable end to aid in distinguishing the P6231 tip from other subminiature probe tips. To install a replacement probe tip, simply reverse the procedure.

READJUSTMENT AFTER REPAIR

After any electrical component has been replaced, complete the "Performance Check Procedure" (Section 3) to verify that the probe is within specification limits. If adjustment is necessary, perform the appropriate "Adjustment Procedure" (Section 4).

INSTRUMENT REPACKING

Required Reshipment Information

If the probe is to be shipped to a Tektronix Service Center for service or repair, attach a tag (before packaging) that contains the following information.

1. Owner's name and address, with the name of an individual at your firm that can be contacted.

2. Description of the service required.

To repackage the probe:

1. Obtain a corrugated cardboard carton having inside dimensions of no less than 2 inches more than probe dimensions to allow cushioning. Use a carton having a test strength of at least 175 pounds.
2. Surround the probe with protective polyethylene sheeting.

3. Cushion the probe on all sides by tightly packing dunnage or urethane foam between carton and probe, allowing 2 inches on all sides.

4. Seal carton with shipping tape or industrial stapler.
Symbols and Reference Designators

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

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

- **Resistors** = Ohms (Ω).

Symbols used on the diagrams are based on USA Standard Y32.2-1967.

Logic symbology is based on MIL-STD-806B in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

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

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

Section 7—P6231
The following special symbols are used on the diagrams:

- Cam Switch Closure Chart
- Internal Screwdriver Adjustment
- Test Voltage
- Plug to E.C. Board
- Panel Adjustment
- Plug Index
- Modified Component—See Parts List
- Refer to Waveform
- Refer to Diagram Number
- SEL Value Selected at Factory
- Coaxial Connector
- Panel Connector
- Assembly Number
- Board Name
- Etched Circuit Board Outlined in Black
- Schematic Name and Number

```
Replaceable Parts— P6231
```
Figure 7-1. Main circuit board schematic.
Figure 7-2. Flexible circuit board schematic.

Replaceable Parts— P6231

REV MAR 1987
Figure 7-3. Main circuit board component layout for trouble shooting.

Replaceable Parts— P6231
REPLACEABLE PARTS

PARTS ORDERING INFORMATION

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

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

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

FIGURE AND INDEX NUMBERS

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

ITEM NAME

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

INDENTATION SYSTEM

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

1 2 3 4 5 Name & Description
Assembly and/or Component
Attaching parts for Assembly and/or Component
--- • ---
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
--- • ---
Parts of Detail Part
Attaching parts for Parts of Detail Part
--- • ---

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

Attaching parts must be purchased separately, unless otherwise specified.
## CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

<table>
<thead>
<tr>
<th>Mfr. Code</th>
<th>Manufacturer</th>
<th>Address</th>
<th>City, State, Zip Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>80009</td>
<td>TEKTRONIX INC</td>
<td>4900 S W GRIFFITH DR</td>
<td>BEAVERTON OR 97077</td>
</tr>
<tr>
<td>TK1473</td>
<td>RICHARD HIRSCHMANN OF AMERICA</td>
<td>PO BOX 229/INDUSTRIAL ROW</td>
<td>RIVERDALE NJ 07457</td>
</tr>
<tr>
<td>TK1556</td>
<td>CONSOLIDATED VINYL SALES</td>
<td>1237 S SAN GABRIEL BLVD</td>
<td>SAN GABRIEL CA 91776</td>
</tr>
</tbody>
</table>

## Replaceable Parts - P6231

<table>
<thead>
<tr>
<th>Fig. &amp; Index No.</th>
<th>Tektronix Part No.</th>
<th>Serial/Assembly No.</th>
<th>Qty</th>
<th>Effective Date</th>
<th>Description</th>
<th>12345</th>
<th>Name &amp; Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>174-0246-00</td>
<td></td>
<td>1</td>
<td></td>
<td>CABLE ASSY, RF: 50 OHM COAX, 1.5M</td>
<td>80009</td>
<td>174-0246-00</td>
</tr>
<tr>
<td>-2</td>
<td>206-0279-00</td>
<td></td>
<td>1</td>
<td>8627</td>
<td>TIP ASSY, PROBE: 10X, YELLOW/BLUE</td>
<td>80009</td>
<td>206-0279-00</td>
</tr>
<tr>
<td>-3</td>
<td>206-0279-10</td>
<td></td>
<td>1</td>
<td></td>
<td>TIP ASSY, PROBE: 10X, YELLOW/BLUE</td>
<td>80009</td>
<td>206-0279-10</td>
</tr>
<tr>
<td>-4</td>
<td>343-1003-01</td>
<td></td>
<td>1</td>
<td></td>
<td>COLLAR, GND:</td>
<td>80009</td>
<td>343-1003-01</td>
</tr>
<tr>
<td>-5</td>
<td>204-0925-01</td>
<td></td>
<td>1</td>
<td></td>
<td>BODY SHL, PROBE:</td>
<td>80009</td>
<td>204-0925-01</td>
</tr>
<tr>
<td>-6</td>
<td>200-2747-00</td>
<td></td>
<td>1</td>
<td></td>
<td>COVER, PROBE TIP:</td>
<td>80009</td>
<td>200-2747-00</td>
</tr>
<tr>
<td>-7</td>
<td>343-1279-00</td>
<td></td>
<td>2</td>
<td></td>
<td>CLAMP, CABLE: SLATE GRAY, ABS</td>
<td>80009</td>
<td>343-1279-00</td>
</tr>
<tr>
<td>-8</td>
<td>200-3317-00</td>
<td></td>
<td>1</td>
<td></td>
<td>COVER, COMP BOX: TOP &amp; BOTTOM W/ LABEL &amp; REMOVAL TO OL</td>
<td>80009</td>
<td>200-3317-00</td>
</tr>
<tr>
<td>-9</td>
<td>670-9726-01</td>
<td>B010100</td>
<td>1</td>
<td></td>
<td>CIRCUIT BD ASSY: FLEX, TESTED W/ ID</td>
<td>80009</td>
<td>670-9726-01</td>
</tr>
<tr>
<td>-10</td>
<td>670-9726-03</td>
<td>B010510</td>
<td>1</td>
<td></td>
<td>CIRCUIT BD ASSY: FLEX, TESTED</td>
<td>80009</td>
<td>670-9726-03</td>
</tr>
<tr>
<td>-11</td>
<td>670-9596-00</td>
<td></td>
<td>1</td>
<td></td>
<td>CIRCUIT BD ASSY: MAIN</td>
<td>80009</td>
<td>670-9596-00</td>
</tr>
<tr>
<td>-12</td>
<td>344-0397-00</td>
<td></td>
<td>1</td>
<td></td>
<td>CLIP, SPR TNSN: 0.80 L X 0.406 X 0.2, BE CU</td>
<td>80009</td>
<td>344-0397-00</td>
</tr>
<tr>
<td>-13</td>
<td>131-3733-00</td>
<td></td>
<td>1</td>
<td></td>
<td>CONNECTOR ASSY: BNC, 7 PIN ID</td>
<td>80009</td>
<td>131-3733-00</td>
</tr>
<tr>
<td>-14</td>
<td>131-3627-00</td>
<td></td>
<td>7</td>
<td></td>
<td>. CONTACT, ELEC: GOLD PLATED TIP</td>
<td>80009</td>
<td>131-3627-00</td>
</tr>
</tbody>
</table>

REV MAR 1987

Replaceable Parts - P6231
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-13</td>
<td>131-2766-03</td>
<td></td>
<td>1</td>
<td>CONECTOR,PROBE:W/ SOCKET, DATA SHEET</td>
<td>80009 131-2766-03</td>
</tr>
<tr>
<td>-14</td>
<td>344-0398-00</td>
<td></td>
<td>1</td>
<td>CLIP, ELECTRICAL: ALLIGATOR, 0.155 L, STL CS PL</td>
<td>80009 344-0398-00</td>
</tr>
<tr>
<td>-15</td>
<td>013-0208-00</td>
<td>8627</td>
<td>1</td>
<td>TIP, PROBE: RETRACTABLE HOOK</td>
<td>80009 013-0208-00</td>
</tr>
<tr>
<td>-16</td>
<td>016-0633-00</td>
<td></td>
<td>1</td>
<td>MARKER SET, CA: 2 EA, 9 COLORS</td>
<td>80009 016-0633-00</td>
</tr>
<tr>
<td>-17</td>
<td>013-0217-00</td>
<td></td>
<td>1</td>
<td>GRABBER, IC LEAD: BLACK, 2.047 L X 0.137 DIA</td>
<td>TK1473 973 592 500</td>
</tr>
<tr>
<td>-18</td>
<td>003-1364-00</td>
<td></td>
<td>1</td>
<td>SCREWDRIVER: ADJUSTMENT TOOL, METAL TIP</td>
<td>80009 003-1364-00</td>
</tr>
<tr>
<td>-19</td>
<td>196-3113-00</td>
<td></td>
<td>1</td>
<td>LEAD, ELECTRICAL: STRD, 26 AWG, 6.0 L, 0-N W/ CLR</td>
<td>80009 196-3113-00</td>
</tr>
<tr>
<td>-20</td>
<td>195-4240-00</td>
<td></td>
<td>1</td>
<td>LEAD, ELECTRICAL: 0.025 DIA, COPPER, 2.3 L</td>
<td>80009 195-4240-00</td>
</tr>
<tr>
<td></td>
<td>016-0706-00</td>
<td></td>
<td>1</td>
<td>POCH, ACCESSORY:</td>
<td>TK1556 ZIP-6.25X9.25ID</td>
</tr>
<tr>
<td></td>
<td>070-6027-00</td>
<td></td>
<td>1</td>
<td>MANUAL, TECH: INSTR, P6231</td>
<td>80009 070-6027-00</td>
</tr>
<tr>
<td></td>
<td>003-1383-00</td>
<td></td>
<td>1</td>
<td>RLSE TOOL, COVER: COMP BOX, POLYCARBONATE</td>
<td>80009 003-1383-00</td>
</tr>
<tr>
<td></td>
<td>013-0195-00</td>
<td></td>
<td>1</td>
<td>ADAPTER, CONN: BNC TO PROBE</td>
<td>80009 013-0195-00</td>
</tr>
<tr>
<td></td>
<td>013-0197-00</td>
<td></td>
<td>1</td>
<td>KLIPKIT: (2) 16 PIN CLIP W/ (4) CONTACT GROUND</td>
<td>80009 013-0197-00</td>
</tr>
<tr>
<td></td>
<td>017-0520-00</td>
<td></td>
<td>1</td>
<td>CONN, PLUG, ELECT: 50 OHM COAX</td>
<td>80009 017-0520-00</td>
</tr>
<tr>
<td></td>
<td>131-2766-01</td>
<td></td>
<td>1</td>
<td>CONNECTOR, PROBE: PACKAGE OF 100</td>
<td>80009 131-2766-01</td>
</tr>
</tbody>
</table>

**STANDARD ACCESSORIES**

**OPTIONAL ACCESSORIES**

Replaceable Parts - P6231

REV MAR 1987