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Part No. 070-7055-00
Product Group 47
Instrument Serial Numbers

Each instrument manufactured by Tektronix has a serial number on a panel insert, tag, or stamped on the chassis. The first letter in the serial number designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument. Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

- B010000 Tektronix, Inc., Beaverton, Oregon, USA
- G100000 Tektronix Guernsey, Ltd., Channel Islands
- E200000 Tektronix United Kingdom, Ltd., London
- J300000 Sony/Tektronix, Japan
- H700000 Tektronix Holland, NV, Heerenveen, The Netherlands

Instruments manufactured for Tektronix by external vendors outside the United States are assigned a two digit alpha code to identify the country of manufacture (e.g., JP for Japan, HK for Hong Kong, etc.).

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

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Part 4 Amplitude ............. 21
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Part 5 Rise Time ............. 24
  Setup to Check Rise Time .... 24
  Procedure to Check Rise Time . 25
To avoid personal injury, do not remove the protective cabinet panels or covers on the oscilloscope mainframe. Operate this oscilloscope only when the panels or covers are properly installed.

The SD-24 TDR/Sampling Head is a high performance sampling head that can be installed in the 11800-Series of the Digital Sampling Oscilloscopes and in the SM-11 Multi-Channel Unit. The Functional Test verifies the overall functionality of the sampling head.

The following Functional Test procedure is provided for the operator and should be performed with all sampling head and oscilloscope mainframe covers properly installed.

This general safety information is directed to operators and service personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

Terms in Manuals

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

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

Terms on Equipment

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

DANGER on equipment means a personal injury hazard immediately accessible as one reads the marking.
Symbols in Manuals

Static Sensitive Devices

Symbols on Equipment

DANGER
High Voltage

Protective ground (earth) terminal

ATTENTION
Refer to manual

Grounding the Instrument

This product is grounded through the grounding conductor of the oscilloscope mainframe (oscilloscope mainframe refers to the 11801 or 11802 instrument specifically, and does not include the sampling head) power cord. To avoid electric shock, plug the oscilloscope mainframe power cord into a properly wired receptacle, where earth ground has been verified by a qualified service person, before making connections to the input or output terminals of the instrument. A protective-ground connection, by way of the grounding conductor in the oscilloscope mainframe power cord, is essential for safe operation.

Danger Arising from Loss of Ground

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

To avoid fire hazard, use only a fuse which is identical in type, voltage rating, and current rating to the fuse specified in the parts list for your product.

Do Not Operate in Explosive Atmospheres

To avoid explosion, do not operate this product in an atmosphere of explosive gasses.

Do Not Remove Covers or Panels

To avoid personal injury, do not remove the protective covers. Do not operate this instrument without the panels or covers properly installed.

Electro-Static Discharge

Acquisition circuitry in the sampling heads is very susceptible to damage from electrostatic discharge and from overdrive signals and DC voltages. Be sure to operate the instrument in a static-controlled environment. Be sure to discharge to ground any electrostatic charge that may be present on cables before attaching the cable to the sampling head.

Whenever you remove a sampling head from the oscilloscope, install short circuit terminations on the sampling head connectors. Be sure to store the sampling head in a static-free container, preferably the shipping container. Whenever you move the sampling head from one oscilloscope to another, use a static-free container to carry the head.

Be sure to follow the precautions described in the manuals accompanying your sampling head and oscilloscope mainframe, to prevent electro-static damage to the oscilloscope mainframe and sampling heads.
Sampling Head Installation and Removal

**CAUTION**
Never install or remove a sampling head when the ON/STANDBY switch is ON.

To avoid damage to the oscilloscope mainframe, set the oscilloscope mainframe’s ON/STANDBY switch to STANDBY before installing or removing sampling heads.

The SD-24 TDR/Sampling Head slides into one of the front-panel compartments of the 11801 or 11802 Digital Sampling Oscilloscopes. The figure below shows the front panel of the 11801 Digital Sampling Oscilloscope and the locations of the sampling head compartments.

With the ON/STANDBY switch set to STANDBY, place the sampling head in a compartment and slowly push it in with firm pressure. Once the sampling head is seated, turn the lock-down screw to tighten the sampling head into place.

To remove the sampling head, set the ON/STANDBY switch to STANDBY. Turn the lock-down screw to loosen the sampling head, and then slowly pull out the sampling head.

---

**Sampling Head Compartments**

---

**Connector Care**

The front of the sampling head has two precision 3.5 mm SMA connectors, one for each channel.
They are for attaching the signal cable or the device under test. These are high-precision connectors with a closer mechanical tolerance than standard SMA cable connectors. Never attach a cable to a sampling head connector if the cable has a worn or damaged connector; this could cause damage to the oscilloscope mainframe.

Use extra care when attaching or removing a cable from the connectors. Turn only the nut of the cable, not the cable itself. When attaching a cable to a sampling head connector, align the connector and nut carefully before turning the nut. Use light finger pressure to make this initial connection. Then tighten the nut lightly with a wrench.

To prolong the life of both the connector and cable use a torque wrench and tighten the connection to the range of 7-10 lb-in (79-112 N-cm).

If the sampling head connectors are used extensively, such as in a production environment, you should use an adapter (for example a connector saver) installed on the sampling head connector to make connection to the device under test.
Test Equipment

The Test Equipment table below contains suggested test equipment for use with the Functional Test. Procedure steps are based on the test equipment examples given, but other equipment with similar specifications may be substituted. However, test results, setup information, and related connectors and adapters may be altered by the use of different equipment.

Test Equipment

<table>
<thead>
<tr>
<th>Description</th>
<th>Minimum Specification</th>
<th>Examples of Applicable Test Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>11800-Series Oscilloscope Mainframe</td>
<td>Tektronix digital sampling oscilloscope mainframe</td>
<td>TEKTRONIX 11801 Digital Sampling Oscilloscope TEKTRONIX 11802 Digital Sampling Oscilloscope</td>
</tr>
<tr>
<td>Termination 50 Ω, SMA</td>
<td>Impedance, 50 Ω; SMA connectors</td>
<td>Tektronix Part No. 015-1022-00</td>
</tr>
</tbody>
</table>

Using This Procedure

This procedure allows you to perform an electrical inspection of the sampling head with a minimum number of steps. The SD-24/TDR Sampling Head Functional Test flow chart that follows illustrates the organization of this procedure.

Some parts begin with a Setup illustration that shows what test equipment is needed and how to connect it. The other parts require only a calibrated SD-24/TDR Sampling Head installed in an 11801/11802 Digital Sampling Oscilloscope. Refer to the Test Equipment table, for an example of the test equipment for each part.
Conventions in this Manual

In these procedures, the following conventions are used:

- CAPITAL letters within the body of text identify front-panel controls, indicators, and connectors (for example, SELECT CHANNEL) on the sampling head and oscilloscope.

- **Bold** letters identify menu labels and display messages.

- Initial Capital letters identify connectors, controls, and indicators (for example, On) on associated test equipment.

In some steps, the first word is italicized to identify a step that contains a performance verification and/or an adjustment instruction. For example, if Check is the first word in the title of a step, an electrical specification is checked. If Adjust appears in the title, the step involves an electrical adjustment.

Also, the term mainframe is used to identify the 11801 or 11802 instrument specifically, and does not include the sampling head.

Initialized and Stored Settings

At the beginning of most steps, the user is instructed to initialize the oscilloscope. The Initialize feature, located in the UTILITY major menu, presets all oscilloscope controls and functions, excluding the calibration constants, to default values. Initializing at the beginning of a part eliminates the possibility of settings from previous parts causing erroneous or confusing results.

Menu Selections and Measurement Techniques

Details on measurement techniques and instructions for making menu selections are generally not included in this procedure. Comprehensive descriptions of menus and oscilloscope features are located in the 11801 User Reference manual, 11802 User Reference manual and the SD-24/TDR Sampling Head Installation/User Manual.
Tutorial Manual

The tutorial manuals, Introducing the 11801 Digitizing Sampling Oscilloscope or Introducing the 11802 Digitizing Sampling Oscilloscope, are strongly recommended to familiarize the first-time user with 11801/11802 controls and features.

Servicing

If the SD-24 TDR/Sampling head needs servicing, contact the Tektronix Service Center nearest your location for information.
1. Power-on and Warmup (20-minute wait)

2. Offset Accuracy
   - Have both channels been checked?
     - NO
     - YES

3. Dot Response
   - Have both channels been checked?
     - NO
     - YES

4. Amplitude
   - Has the positive and negative step been checked for both channels?
     - NO
     - YES

5. Rise Time
   - Has the positive and negative step been checked for both channels?
     - NO
     - YES

SD-24/TDR Sampling Head Functional Test flow chart.
Part 1
Power-on and Warmup

This part shows the setup and lists the procedures for power-on. Also, this part contains warmup information.

Setup to Perform Power-on

11801

Setup to Power-on the Oscilloscope

11802
Functional Test

Part 1 Power-on and Warmup

Procedure to Perform Power-on

☐ Step 1: Set the following in the order listed.

- Sampling head . . . . . . . . . . . . . . . . . . . . . . . . Not installed yet
- 11801 Oscilloscope mainframe:
  - ON/STANDBY switch . . . . . . . . . . . . . . . . . . . . . STANDBY

☐ Step 2: Connect the 11801/11802 Oscilloscope mainframe to a suitable power source, but do not turn the power switch on.

☐ Step 3: Install a SD-24 TDR/Sampling Head in one of the oscilloscope mainframe's compartments.

☐ Step 4: Set the rear-panel PRINCIPAL POWER SWITCH and front-panel ON/STANDBY switch to ON.

When the 11801/11802 Oscilloscopes are first used, the rear-panel PRINCIPAL POWER SWITCH should be set to the ON position and left there. All subsequent power on/off switching should be done with the front-panel ON/STANDBY switch. Also, refer to the CAUTION under Sampling Head Installation and Removal.

Power-on Activity – each time the front-panel ON/STANDBY switch is set to ON, the 11801/11802 Oscilloscope perform Kernel Diagnostics on its microprocessor subsystems, followed by Self-Test Diagnostics on most of its major circuits. Failures from either of these two sets of diagnostics may cause the oscilloscope to enter the Extended Diagnostics menu.

When the graticule is displayed and the front-panel settings that were in effect at the last power-down are restored, the oscilloscope has passed Power-on Diagnostics (given that the Extended Diagnostics menu was not displayed).

If either the 11801/11802 Oscilloscopes do not pass diagnostics tests, then that particular oscilloscope mainframe cannot be used for this functional test.
Warmup

For the first 20 minutes after power-on, the oscilloscope is fully usable, but its accuracy is not specified.
Part 2
Offset Accuracy

This part shows the setup and lists the procedure to check the offset accuracy.

Setup to Check Offset Accuracy
Procedure to Check Offset Accuracy

☐ Step 1: Initialize the oscilloscope settings, then make the following settings in the order listed:

Sampling head
- SELECT CHANNEL On/Off: On

11801 Oscilloscope mainframe:
- TRIGGER button: press
- Source: Internal Clock
- Vertical icon: press
- Vert Size: 10 mV/division

☐ Step 2: Press the ENHANCED ACCURACY button.

☐ Step 3: Touch Offset Null and then the channel you are using.

☐ Step 4: Touch Automatic Calibrate and then Proceed in the Offset Nulling pop-up menu.

☐ Step 5: Touch Exit.

☐ Step 6: Touch the vertical icon and then Vert Offset:MX (X is the channel number you are using).

☐ Step 7: Touch 0 and then Enter in Numeric Entry & Knob Res pop-up menu.

☐ Step 8: Press the WAVEFORM button, and then touch Acquire Desc.

☐ Step 9: Set Average N to On, and then touch Set Avg N in the Acquire Description pop-up menu.

☐ Step 10: Set Average N to 64 with the top knob.

☐ Step 11: Press the MEASURE button.
Step 12: Touch **Measurements** and then **Mean** in the **Measurements** pop-up menu.

Step 13: Touch **Mean** in the **MEASURE** major menu, and then set **Data Interval to whole zone** in the **Mean** pop-up menu.

Step 14: *Check* that the **Mean** is $0 \pm 2$ mV.

Step 15: Repeat all of Part 2 for the other sampling head channel.
Part 3
Dot Response

This part shows the setup and lists the procedure to check the dot response.

Setup to Check Dot Response

11801

CH 1
50 Ω Termination

11802

CH 1
50 Ω Termination
Procedure to Check Dot Response

☐ Step 1: Initialize the oscilloscope settings, then make the following settings in the order listed:

Sampling head
- SELECT CHANNEL On/Off ............... On

11801 Oscilloscope mainframe:
- TRIGGER button ....................... press
  - Source pop-up menu ............... Internal Clock
- WAVEFORM button .................... press
- Sampling Head Fnc's ............... select channel
- Sampling Head Fnc’s ............... TDR to On

- AUTOSET button .................... press

☐ Step 2: Press the ENHANCED ACCURACY button, and then touch TDR Amplitude.

☐ Step 3: Touch the appropriate channel number, Automatic Calibrate, and then Proceed in the TDR Amplitude Calibration pop-up menu.

☐ Step 4: Touch Exit.

☐ Step 5: Touch the horizontal icon, and then adjust the Main Size to 20 ns/division.

☐ Step 6: Touch Main Pos and then Set to Min in the Numeric Entry & Knob Res pop-up menu.

☐ Step 7: Press the WAVEFORM button, and then touch Horizontal Desc.

☐ Step 8: Touch Main Record Length in the Horizontal Description pop-up menu, and then adjust the top knob for a Main Record Length of 512.

☐ Step 9: Press the UTILITY button.
Step 10: Touch Instr Options, and then set Vectored Trace to Off in the Instrument Options pop-up menu.

Step 11: Touch Display Intensity in the Instrument Options pop-up menu, and then adjust the top knob for 90% intensity.

Step 12: Touch Exit.

Step 13: Touch Cursors at the top of the screen.

Step 14: Touch Cursor Type in the Cursors major menu and then touch Horizontal Bars in the Cursor Type pop-up menu.

Step 15: Touch Cursor 1 and then touch Fine in the Numeric Entry & Knob Resolution pop-up menu.

Step 16: Set Cursor 1 (top knob) to the average of the bottom of the pulse before the step.

Step 17: Set Cursor 2 (bottom knob) to the top of the step.

Step 18: Read $\Delta V$, and then record this value as $V$ for later use.

Step 19: Press the ENHANCED ACCURACY button, and then touch Loop Gain.

Step 20: Touch the appropriate channel number, and then set Divide by Two Mode to On in the Loop Gain Calibration pop-up menu.

Step 21: Touch Automatic Calibrate and then Proceed in the Loop Gain Calibration pop-up menu.

Step 22: Touch Exit.
Functional Check
Part 3 Dot Response

☐ Step 23: Touch **Cursors** at the top of the screen.

☐ Step 24: Adjust **Cursor 1** to the average of the bottom of the pulse before the step (see the figure that follows).

☐ Step 25: Set **Cursor 2** to the average of the bottom of the pulse under the step.

☐ Step 26: Read $\Delta V$, and then record this value as $VL$ for later use.

☐ Step 27: Set **Cursor 2** to the average of the top of the pulse.

☐ Step 28: Read $\Delta V$, and then record this value as $VH$ for later use.

☐ Step 29: **Check** that the negative dot response error \((-VL/VH) \times 100\%\) is $0 \pm 5\%$.

☐ Step 30: **Check** that the positive dot response error \((100\% \times (VH-V)/(V-VL))\) is $0 \pm 5\%$.

☐ Step 31: **Repeat** all of Part 3 for the other sampling head channel.
SD-24 TDR/Sampling Head Dot Response

<table>
<thead>
<tr>
<th>Cursor</th>
<th>$V_1$</th>
<th>$V_2$</th>
<th>$\Delta V$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal Bars</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Cursor 1 | $-6.499998mV$ | $1.500002mV$ | $7.999999mV$ |
| Cursor 2 | $-6.499998mV$ | $1.500002mV$ |

Remove Trace 1 M1 M2

REV OCT 1988

SD-24 Functional Check
Part 4
Amplitude

This part shows the setup and lists the procedure to check the amplitude.

Setup to Check Amplitude

![Diagram of 11801 and 11802 with CH 1 50 Ω Termination labels]
Procedure to Check Amplitude

☐ Step 1: Initialize the oscilloscope settings, then make the following settings in the order listed:

- Sampling head
  - SELECT CHANNEL On/Off: On
- Oscilloscope mainframe:
  - TRIGGER button: press
  - Source pop-up menu: Internal Clock
  - WAVEFORM button: press
  - Sampling Head Fnc’s: select channel
  - Sampling Head Fnc’s: TDR to On
  - AUTOSET button: press

☐ Step 2: Press the ENHANCED ACCURACY button, and then touch TDR Amplitude.

☐ Step 3: Touch the appropriate channel number, Automatic Calibrate, and then Proceed in the TDR Amplitude Calibration pop-up menu.

☐ Step 4: Touch Exit.

☐ Step 5: Touch the horizontal icon, and then adjust the Main Size to 50 ns/division.

☐ Step 6: Press the WAVEFORM button, and then touch Acquire Desc.

☐ Step 7: Set Average N to On, and then touch Set AvgN in the Acquire Description pop-up menu.

☐ Step 8: Set Average N to 64 with the top knob.

☐ Step 9: Touch the horizontal icon.
Step 10: Touch Main Pos and then Set to Min in the Numeric Entry & Knob Res pop-up menu.

Step 11: Touch Cursors at the top of the screen.

Step 12: Touch Cursor Type and then touch Horizontal Bars in the Cursor Type pop-up menu.

Step 13: Touch Cursor 1 and then touch Fine in the Numeric Entry & Knob Resolution pop-up menu.

Step 14: Set Cursor 1 (top knob) to the average of the bottom of the pulse.

Step 15: Set Cursor 2 (bottom knob) to the average of the top of the pulse.

Step 16: Check that $\Delta V$ is 250 mV $\pm$ 5 mV.

Step 17: Press the WAVEFORM button.

Step 18: Touch Sampling Head Fnc's, and then set TDR Polarity to - in the Sampling Head Functions pop-up menu.

Step 19: Touch Exit.

Step 20: Touch the vertical icon, and then adjust the Vert Offset: MX (X is the channel number you are using) until the negative-going step is centered on the screen.

Step 21: Repeat Steps 11 through 16 for the negative step.

Step 22: Repeat all of Part 4 for the other sampling head channel.
Part 5
Rise Time

This part shows the setup and lists the procedure to check the rise time.

Setup to Check Rise Time

11801

CH 1 50 Ω Termination

11802

CH 1 50 Ω Termination

Setup to Check Rise Time
Procedure to Check Rise Time

☐ Step 1: Initialize the oscilloscope settings, then set the following in the order listed:

- Sampling head
  SELECT CHANNEL On/Off ............... On
- 11801 Oscilloscope mainframe:
  - TRIGGER button ..................... press
  - Source pop-up menu .......... Internal Clock
  - WAVEFORM button ................. press
  - Sampling Head Fnc's .......... select channel
  - Sampling Head Fnc's .......... TDR to On
  - AUTOSET button ................. press

☐ Step 2: Press the ENHANCED ACCURACY button, and then touch TDR Amplitude.

☐ Step 3: Touch the appropriate channel number, Automatic Calibrate, and then Proceed in the TDR Amplitude Calibration pop-up menu.

☐ Step 4: Touch Exit.

☐ Step 5: Touch Vertical icon and then Vertical Offset: MX (X is the channel number you are using).

☐ Step 6: Touch 0 and then Enter in the Numeric Entry & Knob Res pop-up menu.

☐ Step 7: Touch the horizontal icon, and then adjust the Main Size to 100 ns/division.

☐ Step 8: Press the WAVEFORM button, and then touch Acquire Desc.

☐ Step 9: Set Average N to On, and then touch Set AvgN in the Acquire Description pop-up menu.
☐ Step 10: Set Average N to 64 with the top knob.

☐ Step 11: Touch the horizontal icon.

☐ Step 12: Touch Main Pos and then Set to Min in the Numeric Entry & Knob Res pop-up menu.

☐ Step 13: Press the MEASURE button, and then touch Measurements.

☐ Step 14: Touch Rise in the Measurements pop-up menu and then Exit Menu.

☐ Step 15: Touch Rise in the MEASURE major menu, and then set Tracking to off in the Rise pop-up menu.

☐ Step 16: Set the Main Size to 5 ns/division.

☐ Step 17: Adjust the Main Pos so that the step is horizontally centered on the screen.

☐ Step 18: Touch Baseline in the Rise pop-up menu.

☐ Step 19: Touch a blank portion of the screen to exit this menu.

☐ Step 20: Touch Baseline in the MEASURE major menu and then Fine in the Numeric Entry & Knob Res pop-up menu.

☐ Step 21: Adjust the bottom knob to set the Baseline on the average of the bottom of the trace 10 ns before the step (see the figure that follows).
Baseline
10ns Before
The Step

SD-24/TDR Sampling Head Rise Time

104.6ns
5ns/div

-10.7mV
54.63ns

189.2mV

20mV/div

trig'd

28

Teik

Cursors

Window

Def Tra

160

ns

Rise Time

Measurements

Topline 129.25mV
Baseline 1.250001mV

Compare & References

Remove Trace 1
A2g(M1) Main

SD-24 Functional Test
Step 22: Touch the horizontal icon, and then adjust the Main Pos to move the step to the left-most edge of the screen.

Step 23: Set the Main Size to 20 ps/division.

Step 24: Adjust the Main Pos until the step is centered on the screen.

Step 25: Check that Rise is \( \leq 32 \) ps.

Step 26: Press the WAVEFORM button.

Step 27: Touch Sampling Head Fnc's and then set TDR Polarity to - in the Sampling Head Functions pop-up menu.

Step 28: Touch Exit.

Step 29: Touch the vertical icon and adjust the Vert Offset: MX (X is the channel number you are using) until the negative-going step is centered on the screen.

Step 30: Repeat Steps 7 and then 12 through 25 for the negative step.

Note: When checking the negative step; the Baseline is automatically set, and the Topline must be set manually with the top knob. Also all Rise selections must be substituted with Fall selections.

Step 31: Repeat all of Part 5 for the other sampling head channel.
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