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TEK **Functional Test**

Part No. 070-7055-00
Product Group 47

THE SD-24

TDR/SAMPLING HEAD

Please check for CHANGE INFORMATION at the rear of this manual.

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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
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First Printing AUG 1988
Revised OCT 1988

Printed in U.S.A.

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Functional Test

WARNING
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.

Safety Summary

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.

This safety information applies to all operators and service personnel.

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 iclude 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

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 the 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.

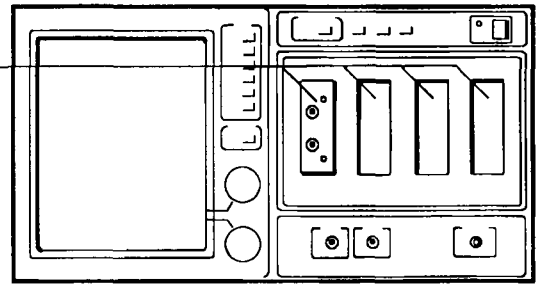
CAUTION

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

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 lockdown screw to loosen the sampling head, and then slowly pull out the sampling head.

Sampling Head Compartments



Sampling head compartments in the 11801 Digital Sampling Oscilloscope

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

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

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.

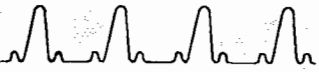
Also, the term mainframe is used to identify the 11801 or 11802 instrument specifically, and does not include the sampling head.

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.

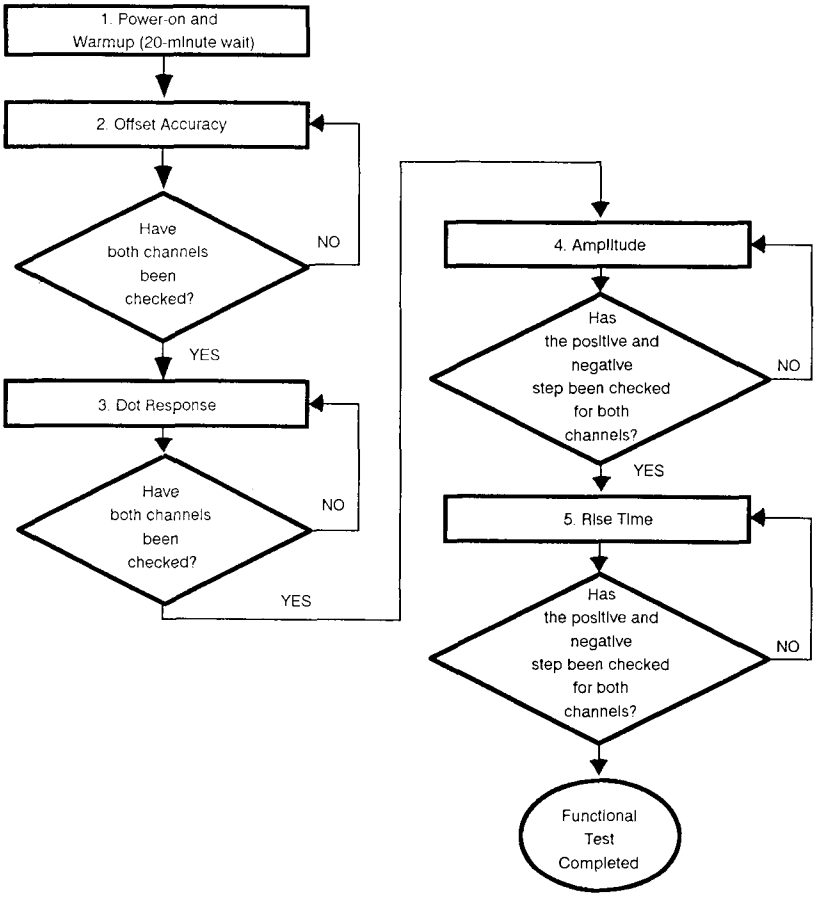


Tutorial Manual

The tutorial manuals, Introducing the 11801 Digitizing Sampling Oscilloscope or Introducing the11802 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.

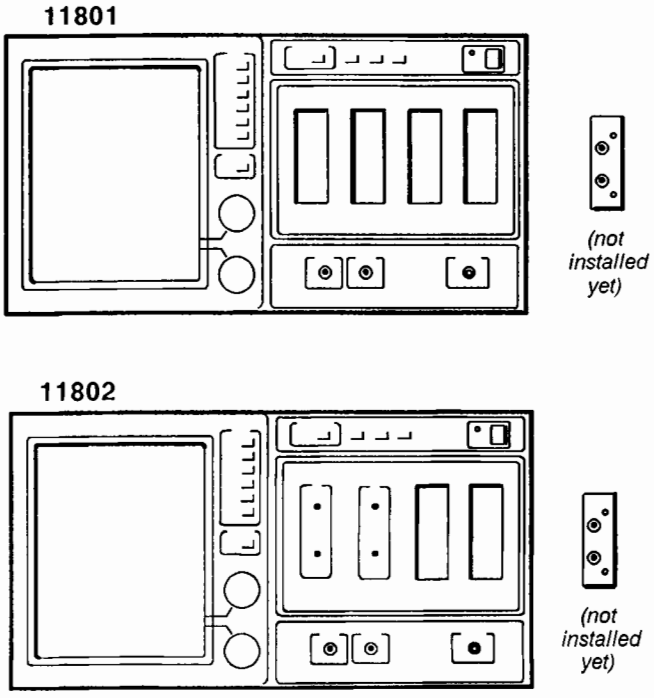


SD-24/TDR Sampling Head Functional Test flow chart.

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



Setup to Power-on the Oscilloscope

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.



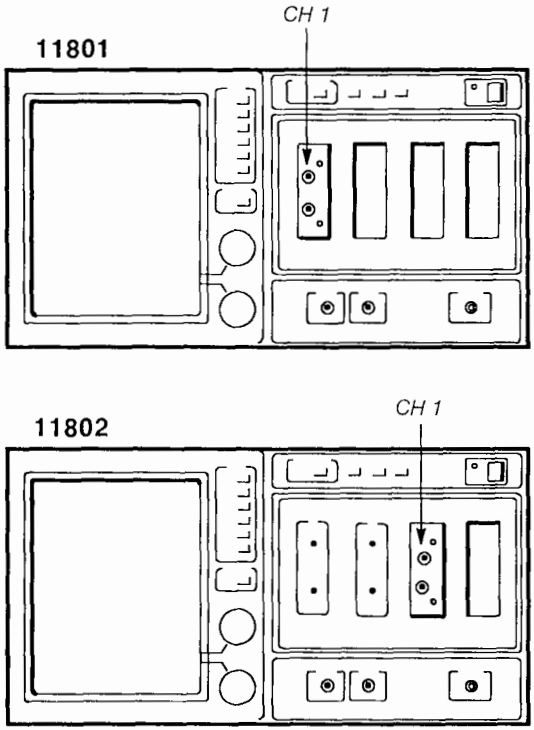
Warmup

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



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).

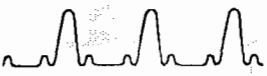
☐ Step 7: Touch **0** and then **Enter** in **Numeric Entry & Knob Res** pop-up menu.

☐ 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.

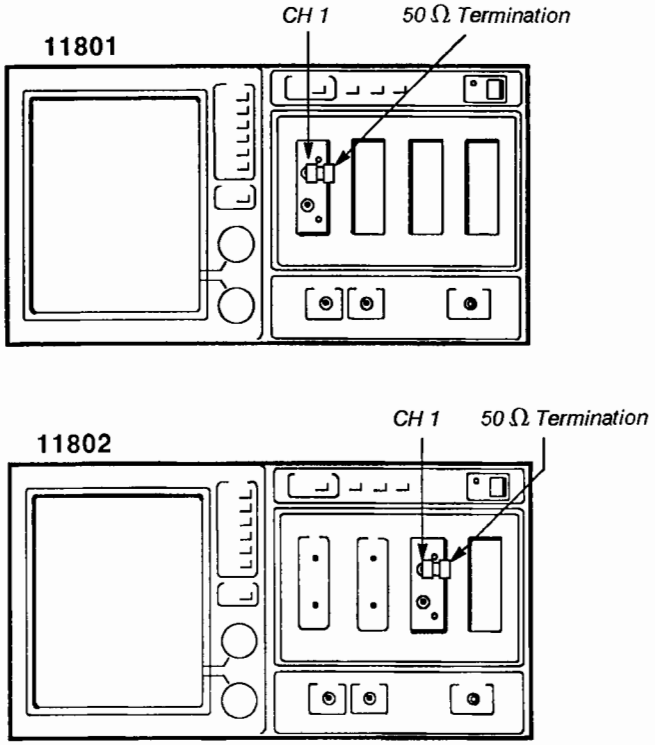
☐ Step 14: *Check* that the **Mean** is 0 ±2 mV.

☐ 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



Setup to Check Dot Response

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 **ΔV**, 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**.

☐ 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 **ΔV**, and then record this value as **V_L** for later use.

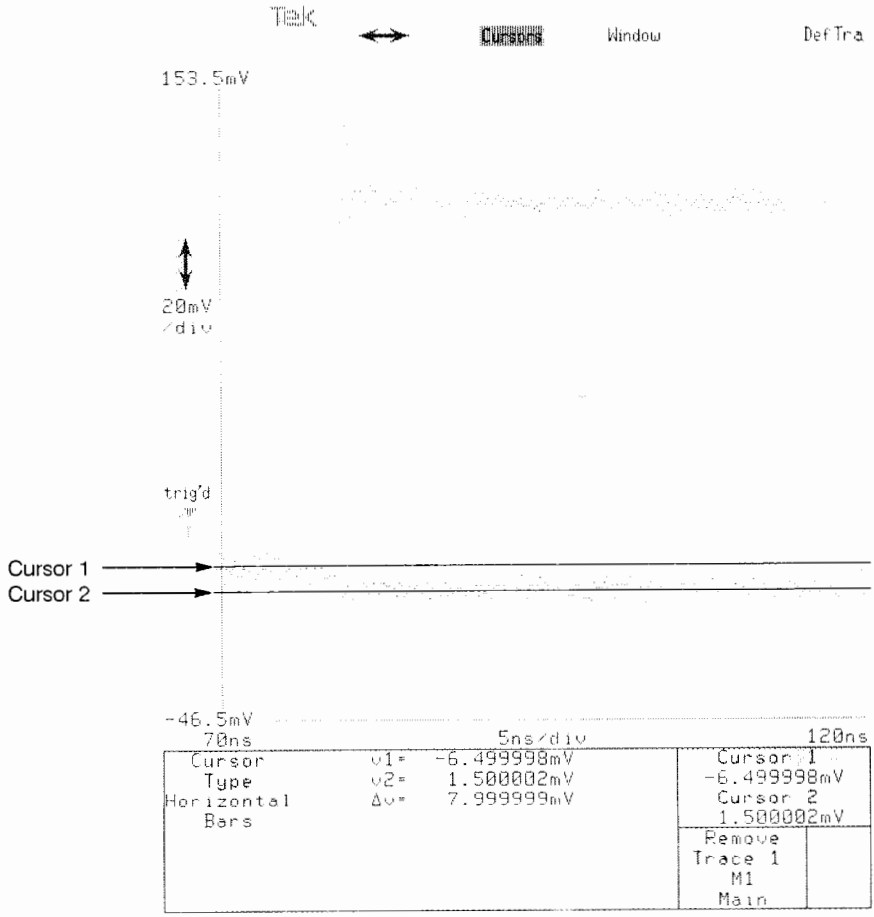
☐ Step 27: Set **Cursor 2** to the average of the top of the pulse.

☐ Step 28: Read **ΔV**, and then record this value as **V_H** for later use.

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

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

☐ Step 31: Repeat all of Part 3 for the other sampling head channel.

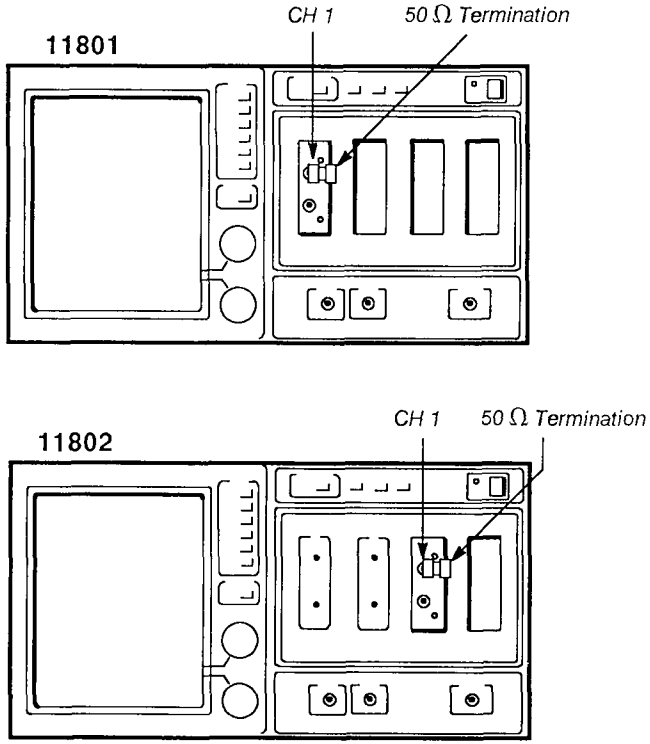


SD-24 TDR/Sampling Head Dot Response

Part 4 Amplitude

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

Setup to Check Amplitude



Setup to Check Amplitude

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
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 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 **ΔV** is 250 mV ±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: M**X (X is the channel number you are using) until the negative-going step is centered on the screen.

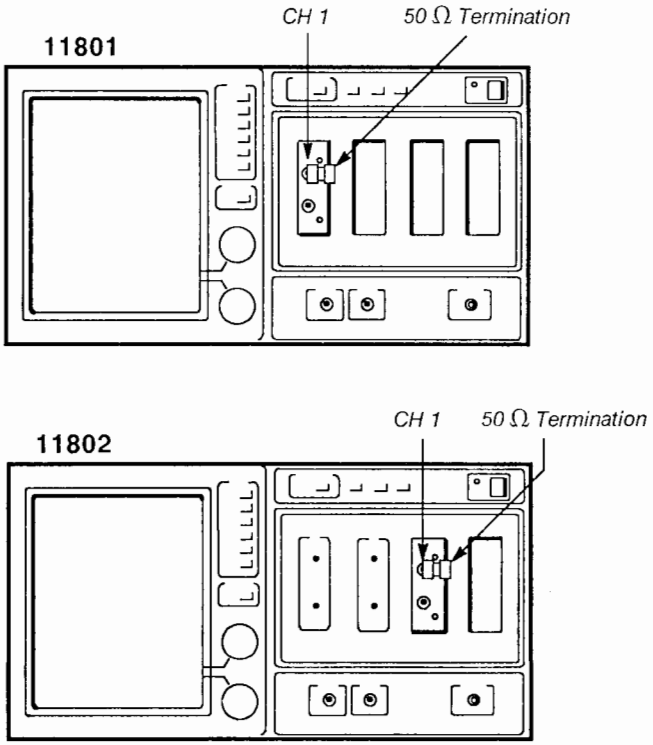
☐ Step 21: Repeat Steps 11 through 16 for the negative step.

☐ 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



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: M**X (X is the channel number you are using).

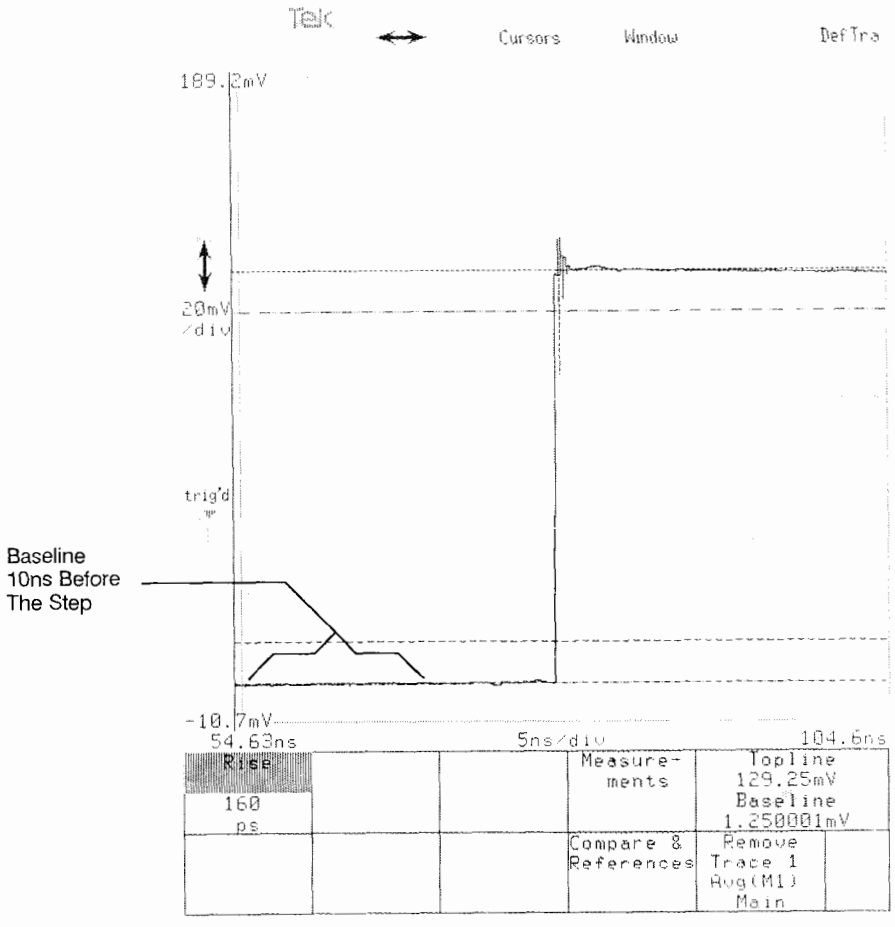
☐ Step 6: Touch **0** and then **Enter** in the **Numeric Entry & Knob Res** pop-up menu.

☐ 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).



SD-24/TDR Sampling Head Rise Time

☐ 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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