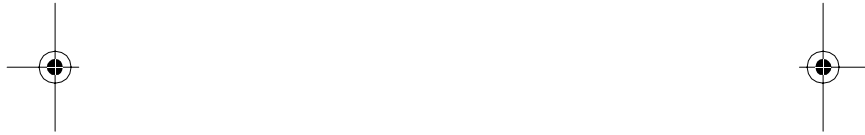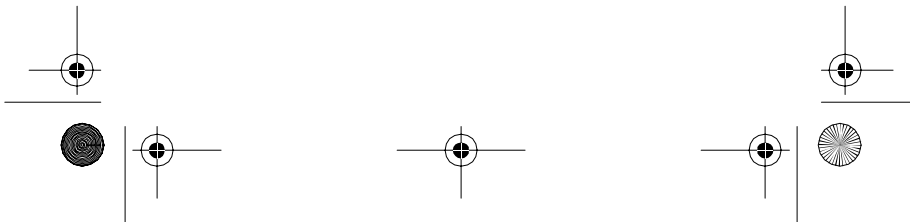Cat. No. 22-310

OWNER'S MANUAL

Please read before using this equipment.

ProbeScope V4.1
for Windows/DOS

Radio Shack

FCC INFORMATION

Modifying or tampering with your Radio Shack Probe-Scope's internal components can cause a malfunction and might invalidate your ProbeScope's warranty and void your FCC authorization to operate it. If your Probe-Scope is not performing as it should, take it to your local Radio Shack store for assistance.

This device complies with Part 15 of the *FCC Rules*. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This device complies with the limits for a Class B digital device, as specified in Part 15 of *FCC Rules*. These limits provide reasonable protection against radio and TV interference in a residential area. However, your ProbeScope might cause TV or radio interference even when it is operating properly. To eliminate interference, you can try one or more of the following:

- Reorient or relocate the TV or radio's antenna.

- Increase the distance between the equipment and the TV or radio.

- When using an AC adapter, use outlets on different electrical circuits for this device and the TV or radio.

If the problem persists, consult your local Radio Shack store for assistance.

SAFETY INSTRUCTIONS

Warning: Use extreme caution in the use of this device. Improper use of this device can result in injury or death. Follow all the safeguards suggested in this owner's manual in addition to normal safety precautions in dealing with electrical circuits. Do not use this device if you are unfamiliar with electrical circuits and testing procedures.

Not for commercial or industrial use.

This oscilloscope is designed to ensure the safest operation possible. However, safe operation depends on you, the operator. Make sure you follow these simple safety rules:

- Read all of these instructions carefully, and save them for your reference.

- Follow all warnings and instructions marked on the ProbeScope.

- When making voltage measurements, never touch the ProbeScope's tip or a hot wire in AC wiring circuits. If you do, you could receive an electric shock.

- Never apply the ProbeScope to a source of power greater than 100V DC/AC peak-to-peak. Doing so could cause electrical shock or damage to the ProbeScope.

    Caution: If you do not know the level of the voltage to measure in manual range control, always start at the highest range: 100V DC or AC.

- Never try to measure any voltage more than 30 VAC on a DC source bias. Doing so might damage your ProbeScope.

3
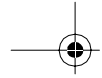
- Always discharge filter capacitors in the circuit under test before you attach the ProbeScope. If the ProbeScope touches an undischarged capacitor, it could damage it. If you touch an undischarged capacitor, you could receive an electric shock.

- Always turn off power and disconnect the ProbeScope before you change power sources.

- Because many AC-DC sets have a potentially hot chassis, be sure the top of your workbench and the floor underneath it are made of nonconductive materials.

- Unplug the ProbeScope before cleaning it. Do not use liquid or aerosol cleaners. Use a damp cloth for cleaning and then wipe it dry immediately.

- Do not use the ProbeScope near water (for example, a bathtub, washbowl, kitchen sink, laundry tub, wet basement, or swimming pool).

- Do not use unapproved attachments.

- The ProbeScope should be operated from a 9-13V DC power source, such as a battery or DC power supply.

- Do not allow anything to rest on the power cord. Do not locate the power supply where people might walk on the cord.

- If your ProbeScope doesn't operate normally, in particular if any unusual sounds or smells come from it, immediately unplug it and contact your local Radio Shack store.

- Do not attempt to service the ProbeScope yourself; opening or removing the cover can expose you to dangerous voltage or other hazards.

4
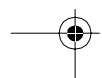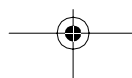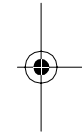
- Unplug the ProbeScope from the DC power source and refer servicing to qualified service personnel under the following conditions:

  — If the power cord is damaged or frayed

  — If the ProbeScope has been exposed to rain or water

  — If the ProbeScope does not operate normally and you are following the operating instructions

  — If the ProbeScope has been dropped or damaged

  — If the ProbeScope exhibits a distinct change in performance

- This Radio Shack ProbeScope is fully calibrated and tested. Under normal use, no further internal adjustment should be necessary. Adjust only those controls covered by the operating instructions. Improper adjustment of other controls might result in damage and might require extensive work by a qualified technician to restore the ProbeScope to normal operation. If the ProbeScope should require repair, do not try to repair it yourself. Take it to your local Radio Shack store.
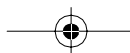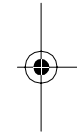
FEATURES

Your Radio Shack ProbeScope V4.1 for Windows/DOS is a microprocessor-controlled oscilloscope and digital voltmeter housed in a small probe with a backlit mini Liquid Crystal Display (LCD). All oscilloscope parameters are menu-driven and selected by pressing one of two push buttons. You can quickly and single-handedly set all parameters while looking at the point of measurement, the probe's controls, and the display. This eliminates the need for any head movement, making the ProbeScope the easiest-to-use measurement tool available.

The ProbeScope includes these features:

Ten Selectable Sampling Rates — lets you display signals in a wide variety of waveforms, from a small fraction of a waveform to multiple waveforms of the measured signal.

Multiple Trigger Sources — lets you select whether the oscilloscope starts a measurement using an internal or an external trigger.

Six Selectable Trigger Levels — lets you select both rising and falling signal events at different levels.

Selectable Input Voltage Ranges — lets you select the range of the measured signal for the most accurate readings.

Selectable Input Coupling — lets you select whether the signal to be measured is DC or AC coupled to the scope, and provides a zero reference for zero adjustment.

Signal Ground Line — lets you easily reference the incoming signal.

Trigger Jack — lets you connect an external trigger source.

Multiple Input Power Sources — lets you connect 9VDC–13VDC external power from a battery using the supplied power cable with alligator clips, or an optional AC adapter.

Liquid Crystal Display (LCD) — displays the recorded signal.

Software Interface — lets you use your computer to display and record measurements.

- To use this ProbeScope's software with Microsoft Windows®, the computer must have at least:

    — 80386 CPU

    — 400K of available hard disk storage space

    — Windows 3.1 or later

- To use this ProbeScope's software with MS-DOS®, the computer must have at least:

    — 800K of available hard disk storage space

    — DOS Version 3.3 or later

CONTENTS

PREPARATION

Use this manual as a guide to prepare and use the ProbeScope using either the ProbeScope's LCD or a computer monitor.

The computer's software offers additional help screens that can guide you through the many ProbeScope functions, modes, and available options.

INSTALLING THE MS-WINDOWS SOFTWARE

1. Start Microsoft Windows.

2. Insert the supplied disk into your computer's A: drive.

3. Click **File** in the Program Manager window.

4. Click **Run**... in the File Menu.

5. Type **a:\setup** in the Command Line box in the Run window, then click $\boxed{\text{OK}}$.

6. Click $\boxed{\text{Continue}}$ in the Setup window to define the directory where you want the software installed. **C:\PROSCOPE** (the suggested path) appears in the Path box.

7. Click $\boxed{\text{Continue}}$ to install the ProbeScope software in the suggested directory, or...

   Enter the desired directory name, then click $\boxed{\text{Continue}}$.

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INSTALLING THE MS-DOS SOFTWARE

If your computer does not have MS-Windows, you can install the supplied MS-DOS software into your computer's C: drive.

1. Type **md c:\proscope** to create a directory on your computer's C: drive where you can install the ProbeScope software.

2. Insert the supplied disk in your computer's A: drive.

3. Type **copy a:*.* c:\proscope** to copy all the files from your A: drive to the C:\proscope directory.

CONNECTING POWER

You can power the ProbeScope from:

• A bench-top power supply (such as Cat. No. 22-120)

• A 9-volt battery (such as Cat. No. 23-553)

• An AC adapter (such as Cat. No. 273-1651)

Using a Bench-Top Power Supply

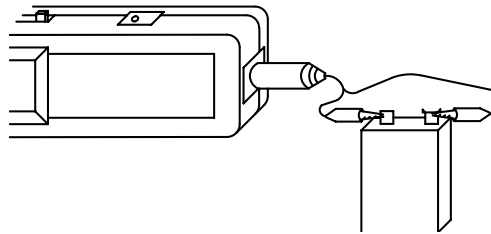If you are using a bench-top power supply or a 9-volt battery:

1. Set the input coupling switch to **GND.**

    Important: You must first set the input coupling switch to **GND** to initialize the probe every time you turn on the ProbeScope, even if you want to measure a circuit's signal using the same settings previously used.

2. Insert the supplied power cable's barrel plug into the Probe-Scope's power jack.
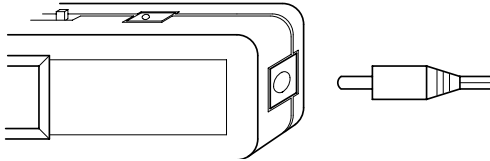
3. Connect the supplied power cable's alligator clips to the DC power source.
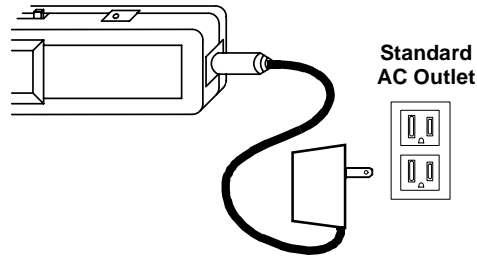

    Cautions:

    • Make sure the input power source is between +9V DC and +13V DC.

    • Make sure to observe the proper polarity by connecting the red clip to + and the black clip to –.

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Using an AC Adapter

If you are using an optional AC adapter:

Standard AC Outlet

1. Set the input coupling switch to **GND.**

   Important: You must first set the input coupling switch to **GND** to initialize the probe every time you turn on the ProbeScope, even if you want to measure a circuit's signal using the same settings previously used.

2. Insert the proper-sized barrel plug into the adapter's wire jack so it reads TIP +.

3. Insert the barrel plug into the ProbeScope's power jack.

4. Connect the AC adapter's power module to a standard AC outlet.

   Caution: Use only an AC adapter that supplies 9–13 volts DC, delivers at least 100 milliamps, and has a barrel plug that correctly fits the Probe-Scope's power jack with its center tip set to positive. The recommended AC adapter meets these specifications. Using an adapter that does not meet these specifications could damage the ProbeScope or the adapter.

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CONNECTING A COMPUTER

1. Plug the supplied serial cable's 9-pin female connector into your computer's 9-pin male serial port connector.

To the Barrel plug

9-Pin Male Serial Port

Serial Cable's 9-Pin Female Connector
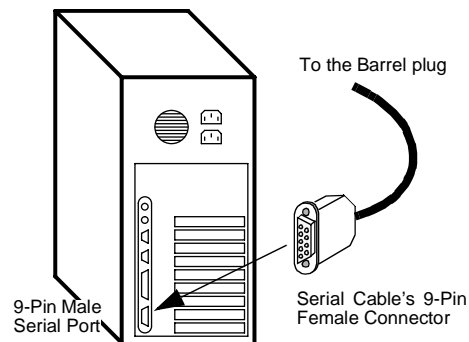
Note: If your computer has a 25-pin serial port connector, you can use a 9-pin to 25-pin adapter cable.

2. Insert the supplied serial cable's barrel plug into the ProbeScope's serial connector.

Serial Cable's Barrel Plug

To the 9-Pin Female Connector

To the Power Source

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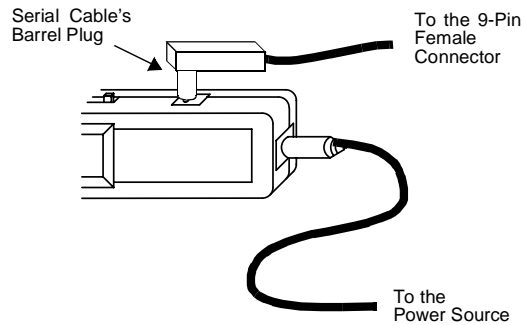
CONNECTING THE EXTERNAL INPUTS

1. Connect the supplied white signal wire's plug into the **GROUND (0 Volt)** jack.

2. If you are using an external trigger source, connect the supplied gray trigger wire's plug into the **EXT. TRIGGER** jack.

Gray Wire

White Wire

Ext.Trigger

Ground (0 Volt)

To the 9-Pin Female Connector
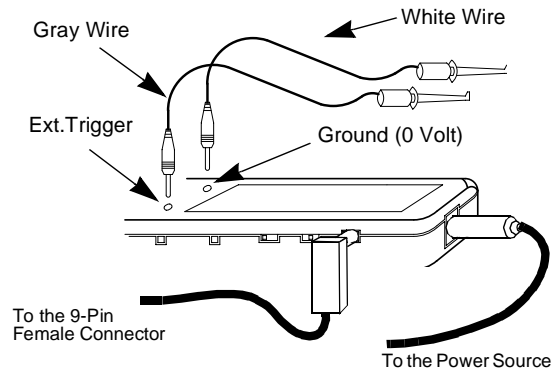
To the Power Source

Caution: If you are not going to use an external trigger source, do not connect the gray trigger wire to the ProbeScope.

BASIC OPERATION
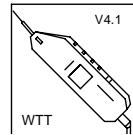
USING THE SOFTWARE

If all you want to do is make a quick and basic signal detection or AC/DC voltage measurement, you can simply use the ProbeScope's display.

But, if you want to make a more detailed determination of a measured signal (such as a frequency, signal amplitude, phase shifting, DC biasing, etc.), you need to use the ProbeScope's software to display the measurements on your computer's monitor.

To use the ProbeScope with your computer:

- If you are using MS-Windows:

  a.Double click the **Radio Shack ProbeScope** Program Group.

  b.Then double click the **Radio Shack Probe-Sope** icon.

- If you are using MS-DOS:

  a.Type **cd c:\proscope** then press **Enter ↵** to enter the ProbeScope directory.

  b.Type **scopedos.exe** to select the Probe-Scope software.
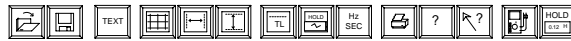
  c.Press **Enter ↵** to start the ProbeScope software.

Note: The operating instructions in this owner's manual are specific to using MS-Windows.

USING THE TOOL BAR

After you start the ProbeScope V4.1 for Windows/DOS software, these icons appear on your monitor's display. (You can also access these functions using the provided keyboard shortcuts.)

Opens an existing ProbeScope document (Ctrl-O)

Saves the active document (Ctrl-S)

Enters comments about the current Probe-Scope document (Ctrl-C)

Shows and hides the oscilloscope screen's grid (Ctrl-G)

Shows and hides the vertical cursors (Ctrl-V)

Shows and hides the horizontal cursors (Ctrl-H)

Shows and hides the trigger level line (Ctrl-L)

Note: You can select this mode only when the **Trigger** mode is set to ± **INTERN** or ± **EXTERN**.

|	
HOLD ⌁	Freezes the measured signal on the oscilloscope display (Ctrl-I)
Hz SEC	Switches between seconds and Hertz for the measured signal (Ctrl-U)
	Note: You can use this mode only when the vertical cursors appear on the oscilloscope display.
🖶	Calls up the print dialog menu (Ctrl-P)
	Turns on and off the Digital Voltmeter (DVM) function (Ctrl-D)
HOLD 0.12 H	Freezes the displayed DVM measured value (Ctrl-A)
	Note: You can use this mode only when the **DVM** function is selected.
?	Provides information about ProbeScope
↖?	Opens the help files (Shift+F1)

USING THE AVAILABLE MODES
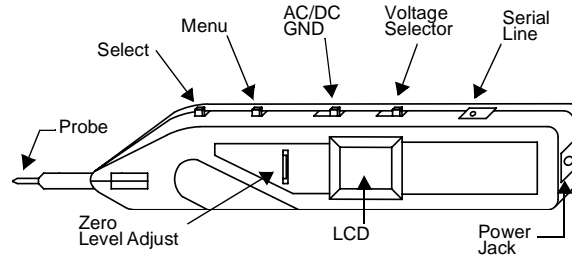
Selecting a Mode

1. Press the Menu button to display the available modes shown below.

2. Press the Select button to set the desired option in each of the available modes.

Mode	Options				
Timebase	Time	Grid Set		Grid Not set	
	50 ns	0.5 ms/div	20 MSa/s	50 ns	20 MSa/s
	100 ns	1 ms/div	10 MSa/s	100 ns	10 MSa/s
	0.5 ms	5 ms/div	2MSa/s	0.5 ms	2 MSa/s
	1 ms	10 ms/div	1 MSa/s	1 ms	1 MSa/s
	5 ms	50 ms/div	200 kSa/s	5 ms	200 kSa/s
	10 ms	100 ms/div	100 kSa/s	10 ms	100 kSa/s
	50 ms		20 kSa/s	50 ms	20 kSa/s
	0.1 ms	0.5 ms/div	10 kSa/s	0.1 ms	10 kSa/s
	0.5 ms	1 ms/div	2 kSa/s	0.5 ms	2 kSa/s
	1 ms	5 ms/div	1 kSa/s	1 ms	1 kSa/s
		10 ms/div			
Trigger Source	AUTO + INTERN − INTERN + EXTERN − EXTERN				
Backlight	ON OFF				

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Mode	Options			
Function	SCOPE		DVM	
Trigger Level	± INTERN			± EXTERN
	± 0.1V ± 0.3V ± 0.5V	± 1V ± 3V ± 5V	± 10V ± 30V ± 50V	± 0.1V ± 0.3V ± 0.5V
Trigger Mode	SINGLE		RUN	

Mode Definitions

Timebase — The ProbeScope's timebase is its sampling rate (the rate at which measurements are taken) and is not always the same as used in typical oscilloscopes.

- The timebase on the ProbeScope's LCD represents the probe's sampling rate and is shown in seconds (such as 0.1 ms, meaning that the ProbeScope takes a measurement every 0.1 ms).

- The timebase on the computer's display depends on whether or not you select the grid overlay to appear on the oscilloscope's display.

  - When the grid is not displayed, the timebase on the computer's display shows the ProbeScope's sampling rate (matches the timebase shown on the ProbeScope's LCD).

  - When the grid is shown, the timebase on the computer's display is 10 times the LCD's sampling rate and is shown in seconds per grid division (the same as in typical oscilloscopes).

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Trigger Source — A trigger source selection deter-mines how a received pulse or signal is to be monitored or measured. The five selectable trigger sources are:

AUTO: The ProbeScope continuously measures and records signals each time a trigger occurs re-gardless of its level (higher, lower, or equal to the incoming signal). If you set the input coupling switch to **GND**, the ProbeScope automatically sets the trigger to **AUTO**.

+ INTERN: The ProbeScope records signals only when the defined trigger event occurs. The signal is recorded when the trigger level is equal to the in-coming signal and the signal is rising.

– INTERN: The ProbeScope records signals only when the defined trigger event occurs. The signal is recorded when the trigger level is equal to the in-coming signal and the signal is falling.

Note: The maximum and minimum voltage levels of the + or – internal trigger depends on the **Input Voltage** Selector
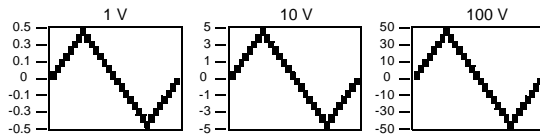
+ EXTERN: The ProbeScope records signals only when the defined trigger event occurs. The signal is recorded when the trigger level is equal to the signal present at the external trigger plug and the signal is rising.

– EXTERN: The ProbeScope records signals only when the defined trigger event occurs. The signal is recorded when the trigger level is equal to the signal present at the external trigger plug and the signal is falling.

Note: The maximum and minimum voltage levels of the + or – external trigger is always ±0.5 V
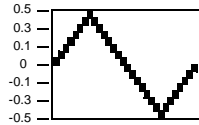
Trigger Mode — The trigger mode determines when a new measurement is to be taken and displayed. These are the two available trigger modes:

`RUN`: The probe records a new signal every time the defined trigger event occurs. Use this mode to measure or monitor a continuously running signal.

`SINGLE`: The probe records a new signal each time you press the Select button and the defined trigger event occurs. Use this mode to measure or monitor a signal that occurs only once, such as the noise heard when you turn on an electronic device.

Backlight — Lights the LCD so you can use it in low light areas.

Function — Lets you use the ProbeScope either as an oscilloscope or a digital voltmeter.

Trigger Level — Establishes the voltage level at which the measurement will begin.

USING THE OSCILLOSCOPE

The following applications describe how to make basic waveform measurements with the ProbeScope. These applications are not described in detail, but are designed to familiarize you with basic oscilloscope operating techniques.

Cautions:

• Never try to measure an AC peak-to-peak or a DC voltage that exceeds 100 volts.

• If you are not sure of what the measured signal level is, always start with the highest range.
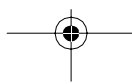
ESTABLISHING THE SCREEN'S VERTICAL DEFLECTION FACTOR

When a measured signal appears on the oscilloscope's screen, you can use the grid overlay to measure the vertical displacement, then multiply this displacement by the deflection factor of the oscilloscope's screen to estimate the measured voltage.
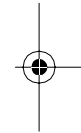
To do this, you must first establish the screen's vertical deflection factor.

1. Click on the grid icon so the screen's grid overlay appears.

2. Divide the input voltage selector setting (1, 10, or 100) by 4 (the number of vertical squares).

Monitor's Display
ProbeScope's Display
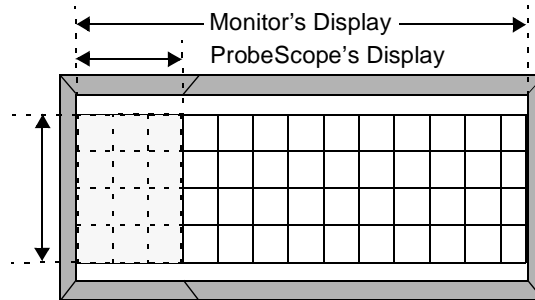
Vertical Deflection

The result is the screen's *vertical deflection factor.* For example, if the input voltage selector is set to 10, and you divide 10 by 4, then the screen's vertical deflection factor is 2.5 volts/square

Therefore, if a measured signal is about 3 squares high, then the signal is estimated to be about 7.5 volts (3 ¥ 2.5 = 7.5).

Notes:

- The screen's deflection factor applies only to the oscilloscope screen on the computer's monitor, and does not apply to the display on the Probe-Scope.

- The grid overlay is not necessary if you want only to detect a signal but do not need to calculate voltage or frequency.

- The grid is necessary in order to calculate voltage, frequency, or both without using the cursors.

MEASURING A DC VOLTAGE

In oscilloscope measurements, the DC component of a waveform is usually measured in terms of its DC flat-line or AC average displacement above or below a reference line.

The maximum DC voltage measurement you can make is determined by the positions of the input voltage selector and the zero line.

For example, if the input voltage selector is set to 10 and the zero line is set at the middle position, the maximum measurement is ±5 Volts.
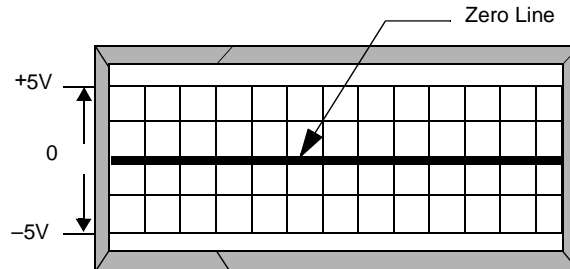
Follow these steps to measure a DC voltage deflection.

1. Continuously press the ProbeScope's Menu button until **DVM** appears on its display, then press the Select button.

2. Set the input coupling switch to **GND**.

   Note: When you set the input coupling switch to **GND**, the ProbeScope automatically resets the trigger mode to **AUTO**.

3. Connect the **GROUND** (0 volt) wire to the signal source's ground or reference level.

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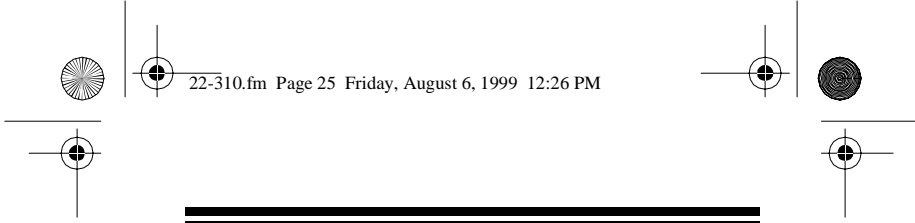
4. Rotate **Zero Level** to position the zero reference line:

   a. On the bottom of the computer display until the ∨ indicator appears on the screen to get the maximum positive (+) measurement, or

   On the top of the computer display until the ∧ indicator appears on the screen to get the maximum negative (–) measurement.

   b. Slowly re-adjust **Zero Level** in the opposite direction until just past the point where the ∨ or ∧ indicator disappears from the oscilloscope screen on the computer's display.

   Notes:

   • The grid must be turned on)

   • The reference line on the oscilloscope display should be set to just above the bottom line or just below the top line on the grid.

   • The position on the grid overlay depends on the input signal's polarity and amplitude, but should be chosen so the trace lies along one of the grid overlay's major divisions. If the trace is widened by stray interference, ground the probe body near the point being measured. The trace position is the voltage reference line and all voltage measurements are read in respect to this line. (Do not adjust the vertical positioning control after the reference is established.)

5. Set **INPUT COUPLING** to **DC**.

6. If it was necessary to ground the tip (see Step 3 note), remove the tip from the ground or reference voltage. This readies the tip so you can use it to make a measurement.
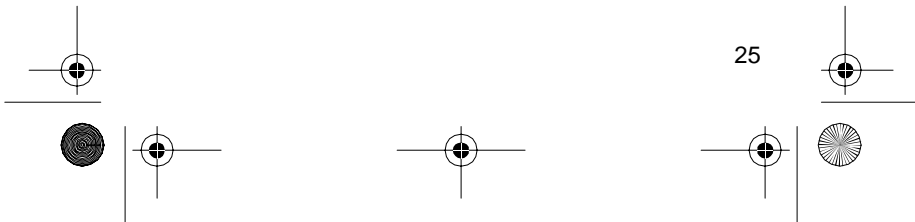
7. Set the input coupling switch to **DC**. The selected setting appears on your computer's monitor.

8. If you know the level of the signal to be measured, set the input voltage switch as follows.

Switch Position	Measures
1V	0.00 – 1.00 V
10V	0.0 – 10.0 V
100V	0 – 100 V

Note: If you do not know the level of the signal to be measured, always set the input voltage switch to **100V**.

9. Click on the horizontal cursor icon to display the horizontal cursors. The —**Volt:** box appears below the grid display.

   a. Place the mouse cursor directly over the oscilloscope screen's lower horizontal cursor until the cursor's shape changes to a cross.

   b. While you press and hold the left mouse button, move the mouse up or down until the screen's lower horizontal cursor is superimposed directly on the reference line.

10. Apply the probe tip to the signal source. The oscilloscope grid display vertically displaces the DC signal's flat-line away from the zero reference line.

11. Click on the oscilloscope hold icon.

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12. Calculate the DC signal using the oscilloscope's grid display as follows:

   a. Place the mouse cursor directly over the oscilloscope screen's upper horizontal cursor until the cursor's shape changes to a cross.

   b. While you press and hold the left mouse button, move the mouse up or down until the screen's upper horizontal cursor is superimposed directly on the DC signal's flat-line waveform.

DC flat-line waveform

MAX

1V
10V
or
100V

Zero Reference Line
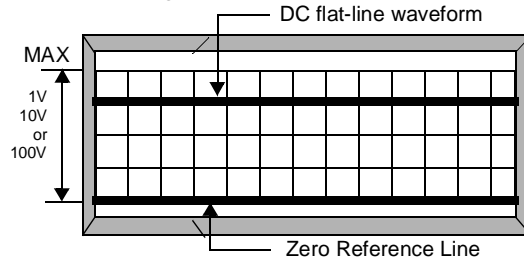
13. Click on the voltmeter icon. The **DVM**: box at the bottom of the computer's display shows the actual DC signal level.

DVM:

7.5 V DC

MEASURING THE DC BIAS VOLTAGE OF AN AC SIGNAL

If you are measuring the DC component of an AC signal (AC on a DC bias), calculate the waveform's average vertical distance from the zero reference line as follows:

Note: The average level of a pure sinusoidal, square, or triangular waveform is the midpoint between the positive and negative signal peaks.

Midpoint
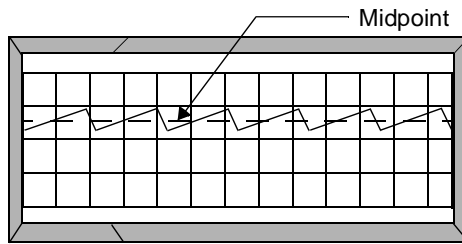
1. Repeat Steps 1–9 of "Measuring a DC Voltage" on Page 24.

2. Apply the probe tip to the signal source. The oscilloscope grid display vertically displaces the signal away from the zero reference line.

3. Click on the oscilloscope hold icon.

4. Calculate the DC bias using the oscilloscope's grid display as follows:

   a. Place the mouse cursor directly over the oscilloscope screen's upper horizontal cursor until the cursor's shape changes to a cross.

b. While you press and hold the left mouse button, move the mouse up or down until the screen's upper horizontal cursor is superimposed directly on the AC signal's midpoint between the positive and negative signal peaks.

DC Signal Level

Zero Reference Line
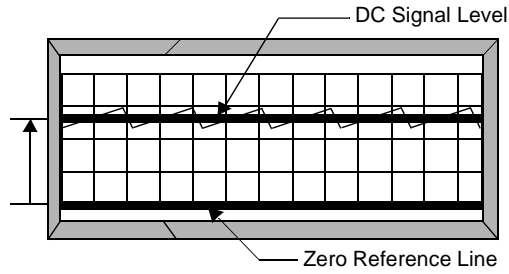
Important: The DVM display does not accurately measure AC on a DC bias. When making this type of measurement, either turn off the DVM display by clicking on the voltmeter icon or disregard its indication.

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MEASURING AN AC VOLTAGE

In oscilloscope measurements, the AC component of a waveform is usually measured in terms of its peak-to-peak value. You can easily make this type of measurement by using the grid overlay on the oscilloscope screen to measure the vertical distance between peaks and multiplying this distance by the oscilloscope screen's deflection factor. The result is the actual peak-to-peak voltage.

Follow these steps to measure a waveform's peak-to-peak AC component.

Caution: To avoid an overload when measuring AC, make sure the zero line is centered vertically on the grid overlay.

1. Set the input coupling switch to **GND**.

   Note: When you set the input coupling switch to **GND**, the ProbeScope automatically resets the trigger mode to **AUTO**.

2. Connect the **GROUND** (0 volt) wire to the signal source's ground or reference level.

3. Rotate **Zero Level** until the zero reference line is centered vertically on the grid overlay.

   Note: If the trace is widened by stray interference, ground the probe body near the point being measured. The trace position is the voltage reference line and all voltage measurements are read in respect to this line. (Do not adjust the vertical positioning control after the reference is established.)
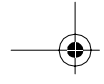
4. If it was necessary to ground the tip (see Step 3 note), remove the tip from the ground or reference voltage. This readies the tip so you can use it to make a measurement.

5. Set the input coupling switch to **AC**.

6. If you know the level of the signal to be measured, set the input voltage switch as follows.

Switch Position	Measures
1V	0.00 – 1.00 V
10V	0.0 – 10.0 V
100V	0 – 100 V

Note: If you do not know the level of the signal to be measured, always set the input voltage switch to **100V**.

7. Click on the horizontal cursor icon to display the horizontal cursors. The **＿Volt:** box appears below the grid display.
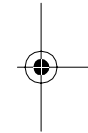
    a. Place the mouse cursor directly over the oscilloscope screen's upper horizontal cursor. The cursor's shape changes to a cross.

    b. While you press and hold the left mouse button, move the mouse up or down until the screen's upper horizontal cursor touches the top of the signal peaks.

8. Apply the probe tip to the signal source, then click on the oscilloscope hold icon.

9. Measure the vertical distance between the positive and negative peaks as follows:
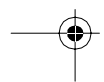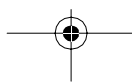
a. Place the mouse cursor directly over the oscillo-scope screen's lower horizontal cursor. The cursor's shape changes to a cross.

b. While you press and hold the left mouse button, move the mouse up or down until the screen's lower horizontal cursor touches the bottom of the signal peaks.

Zero Reference Line
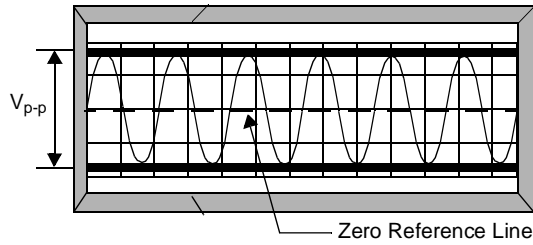
10. Click on the voltmeter icon. The **DVM:** box at the bottom of the computer's display shows the actual AC signal level.

DVM:

3.1 V AC

Notes:

- You can also calculate the approximate voltage level by multiplying the approximate distance by the deflection factor.

- This technique can also be used to make measurements between two other points on the waveform.

- To accurately measure an AC peak-to-peak voltage, you should have at least two complete cycles of a waveform on the display.

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MEASURING AN INSTANTANEOUS VOLTAGE

You can use the ProbeScope to measure an AC signal's instantaneous voltage at any given point on the signal waveform.

1. Set the input coupling switch to **GND**.

2. Connect the **GROUND** (0 volt) wire to the signal source's ground or reference level.

3. Rotate the **Zero Level** to vertically position the trace to a convenient line on the grid overlay.

   Note: The position on the grid overlay depends on the polarity and amplitude of the input signal, but should be chosen so the trace lies along one of the major divisions on the grid overlay. If the trace is widened by stray interference, ground the probe body near the point being measured. The trace position is the voltage reference line and all voltage measurements are read in respect to this line. (Do not adjust the vertical positioning control after the reference is established.)

4. If it was necessary to ground the tip (see Step 3 note), remove the tip from the ground or reference voltage. This readies the tip so you can use it to make a measurement.

5. Set the input coupling switch to **DC**.
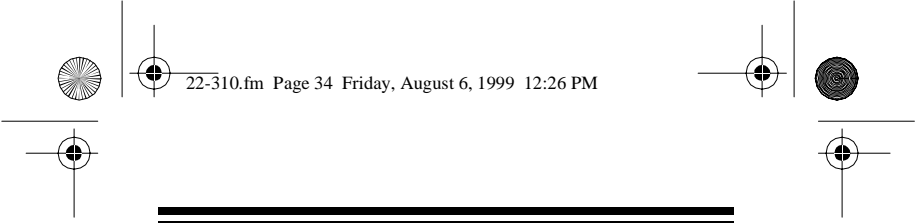
6. Click on the horizontal cursor icon to display the horizontal cursors. The ―**Volt:** box appears below the grid display.

a. Place the mouse cursor directly over the oscilloscope screen's lower horizontal cursor. The cursor's shape changes to a cross.

b. While you press and hold the left mouse button, move the mouse up or down until the screen's lower horizontal cursor touches the reference line.

7. Apply the probe tip to the signal source, then click on the oscilloscope hold icon.

8. Measure the vertical distance between a desired point on the waveform and the reference line as follows:

a. Place the mouse cursor directly over the oscilloscope screen's upper horizontal cursor. The cursor's shape changes to a cross.

b. While you press and hold the left mouse button, move the mouse up or down until you place the screen's upper horizontal cursor on the desired point on the waveform.

Zero Reference Line
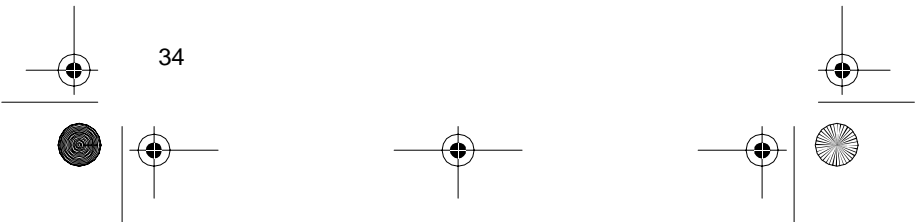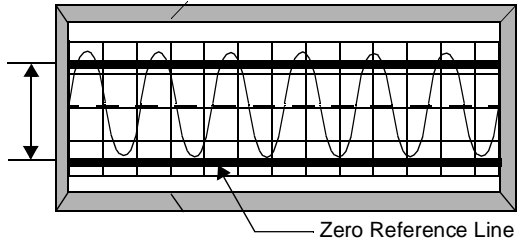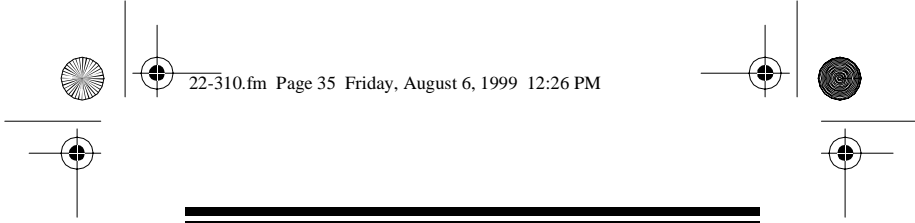
Note: If you place the screen's upper horizontal cursor anywhere along the waveform, the measurement equals the instantaneous voltage.

The **—Volt:** box shows the instantaneous voltage level of the signal at the measured point.

—Volt:

8.7 V

Note: You can also calculate the approximate voltage levels by multiplying the approximate distance by the deflection factor.
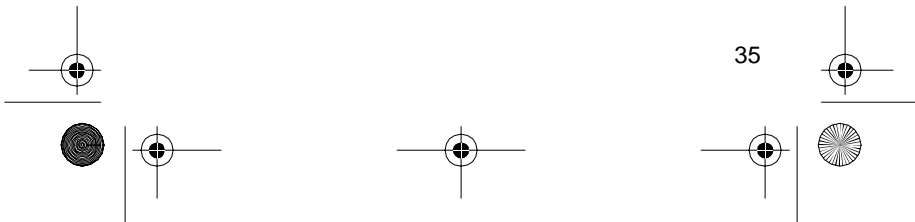
FREQUENCY MEASUREMENTS

Since frequency and time are reciprocals of each other, when you know one (frequency or time), you can easily solve for the other ($f=\frac{1}{t}$, then $t=\frac{1}{f}$). Therefore, if you measure the time period of a recurrent waveform as 0.2 ms, the frequency is 5 MHz (or $\frac{1}{0.2\ ms}$).

Note: Since a DC voltage does not have a frequency, you cannot make frequency measurements on a DC voltage.

1. Set the input coupling switch to **GND**.

2. Connect the **GROUND** (0 volt) wire to the signal source's ground or reference level.

3. Rotate the **Zero Level** to vertically center the trace on the grid overlay.

   Note: If the trace is widened by stray interference, ground the probe body near the point being measured. The trace position is the voltage reference line and all voltage measurements are read in respect to this line. (Do not adjust the vertical positioning control after the reference is established.)

4. If it was necessary to ground the tip (see Step 3 note), remove the tip from the ground or reference voltage. This readies the tip so you can use it to make a measurement.

5. Set the input coupling switch to **AC**.

6. Click on the vertical cursor icon to display the vertical cursors. The —**Time:** box appears below the grid display.

a. Place the mouse cursor directly over the oscillo-scope screen's left vertical cursor. The cursor's shape changes to a cross.

b. While you press and hold the left mouse button, move the mouse left or right until the screen's left vertical cursor touches a point where the rising or falling edge of the waveform intersects with the zero reference line.

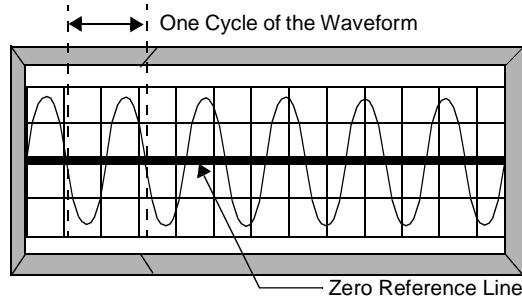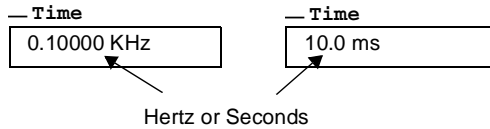7. Apply the probe tip to the signal source, then click on the oscillo-scope hold icon.

8. Measure the horizontal distance between rising or falling points on the displayed waveform as follows:

a. Place the mouse cursor directly over the oscillo-scope screen's right vertical cursor. The cursor's shape changes to a cross.

b. While you press and hold the left mouse button, move the mouse left or right until the screen's right vertical cursor touches the next point where the waveform's rising or falling edge intersects with the zero reference line.
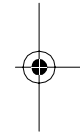
Note: To avoid inaccurate frequency measurements, make sure you set the cursors in Steps 6b and 8b to two consecutive rising or two consecutive falling points of a displayed waveform.
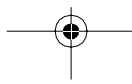
The frequency measurement will be inaccurate if you set one vertical cursor to a rising edge and the other to a falling edge.


One Cycle of the Waveform

Zero Reference Line

c.When you select **HERTZ**, the **＿Time** value represents the signal's frequency. When you select **Seconds**, the **＿Time** value represents the time between the cursors.
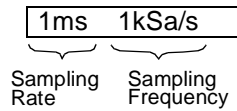
＿Time
0.10000 KHz

＿Time
10.0 ms

Hertz or Seconds

Notes:

• You can click the ⬚ Hz/SEC tool bar button to toggle between Hertz or Seconds.

• The timebase on the computer's **Timebase** display changes with the grid overlay settings.

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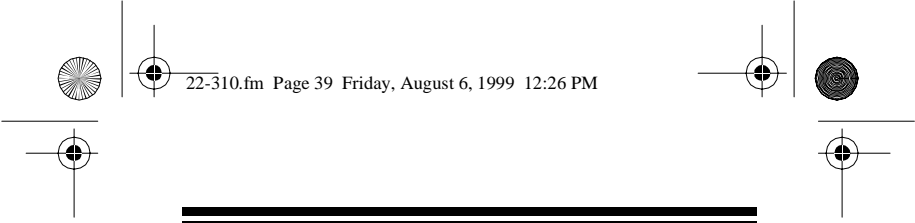
For example:

– If the grid is not shown, then the timebase displayed on the monitor is the same as the ProbeScope's set sampling rate.

$$\underbrace{1ms}_{\substack{\text{Sampling}\\\text{Rate}}}\quad\underbrace{1kSa/s}_{\substack{\text{Sampling}\\\text{Frequency}}}$$

Since $f=\frac{1}{t}$, if the time period of a recurrent waveform is measured as $1ms$, the sampling frequency is 1000 samples per second (or $\frac{1}{1\ ms}$).

– If the grid is shown, then the displayed timebase is the timebase of the grid. This timebase is 10 times the normal sampling rate (because there are 10 samples within each division of the grid).

$$\underbrace{10ms/div}_{\text{Timebase}}\underbrace{1kSa/s}_{\substack{\text{Sampling}\\\text{Frequency}}}$$
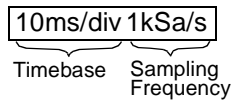
– You can change the timebase by pressing the Select button, without first pressing the Menu button.

• When measuring a waveform:

a. If the either the time or frequency is known, simply calculate the reciprocal of the known value to figure the unknown value.

b. Start with the smallest selectable timebase on the ProbeScope (50 ns) and increase it one step at a time (100 ns, 0.5 ms, 1 ms, 5 ms, 10 ms, 50 ms, 0.1 ms, 0.5 ms, or 1 ms) until the displayed signal shows one or two complete cycles of a waveform.

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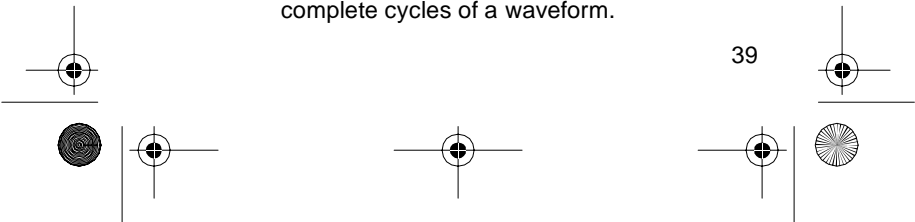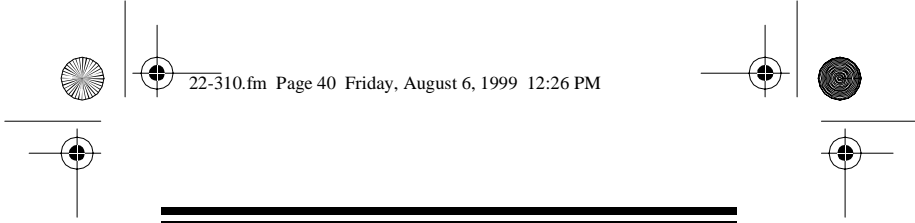
Frequency Measuring Limits:

- You must have a minimum of one complete cycle of a waveform on the display.

- You cannot have more than one cycle per division.

PHASE MEASUREMENTS

You can compare two signal waveforms of the same frequency either from two separate points on the same electronic device, or from similar points on two separate electronic devices. The phase difference between the two signal waveforms is measured in degrees.
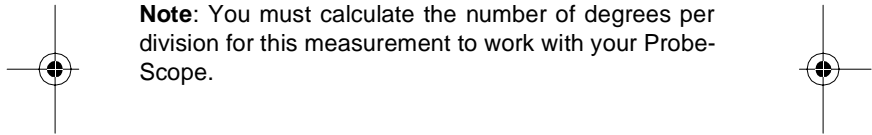
Note: You must calculate the number of degrees per division for this measurement to work with your Probe-Scope.

Grid Overlay Degree Calculation

Since a complete cycle of a sine wave is 360 degrees, it is easy to calibrate the grid overlay in degrees. For example, if the ProbeScope's controls are adjusted so one cycle of the input waveform spans 9 squares on the grid, then each square represents 40 degrees of the complete cycle (360/9=40). The grid display is then considered to be calibrated to 40 degrees per square.
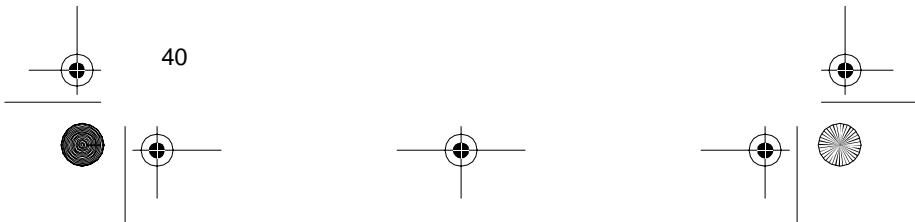
Measuring Phase

Follow these steps to measure the phase difference between two signals.

1. Set the input coupling switch to **GND**.

2. Connect the **GROUND** (0 volt) wire to the signal source's ground or reference level.

3. Rotate **Zero Level** to vertically center the trace on the grid overlay.

   Note: If the trace is widened by stray interference, ground the probe body near the point being measured.

   The trace position is the voltage reference line and all voltage measurements are read in respect to this line. (Do not adjust the vertical positioning control after the reference is established.)

4. If it was necessary to ground the tip (see Step 3 note), remove the tip from the ground or reference voltage. This readies the tip so you can use it to make a measurement.

5. Set the input coupling switch to **AC**.

6. Click on the vertical cursor icon to display the vertical cursors. The **―Time:** box appears below the grid display.
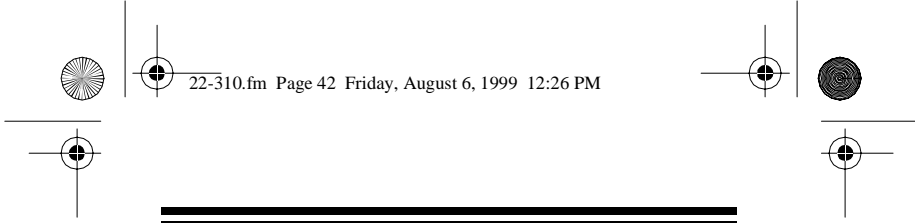
7. Apply the ProbeScope's tip to the first signal source, then click on the oscilloscope hold icon.

8. Measure the slope of the first circuit as follows:

   a. Place the mouse cursor directly over the oscilloscope screen's left vertical cursor. The cursor's shape changes to a cross.
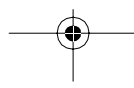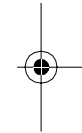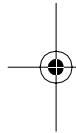
b.While you press and hold the left mouse button, move the mouse left or right until the screen's left vertical cursor touches a point where the rising or falling edge of the first waveform intersects with the zero reference line.

9. If the second signal source to be measured is a separate circuit on the same electronic device, simply remove the ProbeScope's tip from the first circuit's signal source and apply it to the next circuit's signal source.

If the second signal source to be measured is a separate electronic device:

a.Remove the alligator clip on the ground wire and the probe's tip from the first signal source's ground and signal references.

b.Connect the alligator clip on the ground wire to the second signal source's ground reference.

c.Apply the ProbeScope's tip to the second signal source's circuit to be measured.
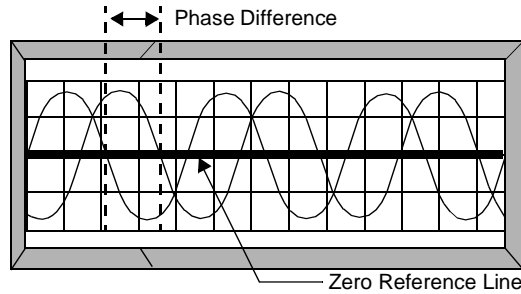
10. Measure the slope of the second circuit as follows:

a.Place the mouse cursor directly over the oscilloscope screen's right vertical cursor. The cursor's shape changes to a cross.

b.While you press and hold the left mouse button, move the mouse left or right until the screen's right vertical cursor touches a point where the rising or falling edge of the second waveform intersects with the zero reference line.
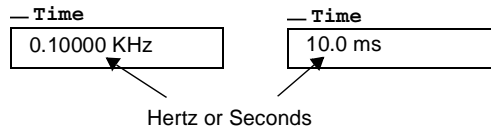
11. Calculate the number of degrees per division (see "Grid Overlay Degree Calculation" on Page 40).
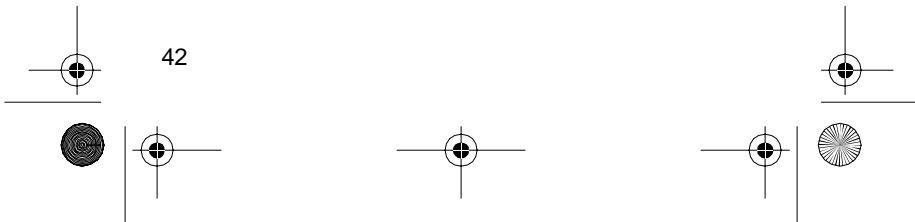
Note: To avoid inaccurate phase measurements, make sure you set the cursors in Steps 8b and 10b to two corresponding rising or two corresponding falling points on the displayed waveforms. The phase measurement will be inaccurate if you set one vertical cursor to a rising edge and the other to a falling edge.

Phase Difference

Zero Reference Line

c. When you select **HERTZ**, the **◢ Time** value represents the signal's frequency. When you select **Seconds**, the **◢ Time** value represents the time between the cursors.

◢ Time

0.10000 KHz

◢ Time

10.0 ms

Hertz or Seconds

Notes:

• You can click the Hz/SEC tool bar button to toggle between Hertz or Seconds.

• The timebase on the computer's **Timebase** display changes with the grid overlay settings.

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12. Divide the displacement between the vertical cursors (the value shown in the **—Time** box) by the value in the timebase (time-per-division), then multiply the result by the number of degrees per division calculated in Step 11.

Note: The relative amplitude of the measured signals does not affect the phase measurement if the signals are centered around the grid's center horizontal line.

Single Sweep Waveform Measurements

You can measure a waveform that occurs only once without repeating, such as a noise spike that occurs when you turn on an electronic device.

Follow these steps to measure a single sweep waveform.

Zero Reference Line
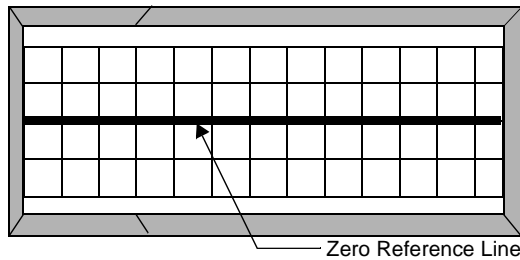
1. Continuously press the Menu button until the trigger mode appears on the display.

2. Set the input coupling switch to **GND**.

3. Connect the **GROUND** (0 volt) wire to the signal source's ground or reference level.

4. Rotate **Zero Level** to vertically position the trace to a convenient line on the grid overlay.

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Note: If the trace is widened by stray interference, ground the probe body near the point being measured. The trace position is the voltage reference line and all voltage measurements are read in respect to this line. (Do not adjust the vertical positioning control after the reference is established.)

5. If it was necessary to ground the tip (see Step 4 note), remove the tip from the ground or reference voltage. This readies the tip so you can use it to make a measurement.

6. Set the input coupling switch to **AC**.

7. Press the Select button to set the trigger mode to:

    - **+ EXTERN** (if you want to trigger on the incoming signal's rising edge), or

    - **– EXTERN** (if you want to trigger on the incoming signal's falling edge).

8. Press the Menu button so `TRIGGER  LEVEL` appears on the ProbeScope's display.

9. Continuously press the Select button until you set the trigger level as desired.

    Note: The trigger level you select sets the level of the incoming waveform that causes the Probe-Scope to begin reading the signal. The Probe-Scope shows the trigger level on the left side of the LCD.

10. Press the Menu button until the `MODE` screen appears on the ProbeScope's display.

11. Press the Select button so `SINGLE` appears on the ProbeScope's display.

12. Press the Menu button so `WAITING!` appears on the ProbeScope's display.
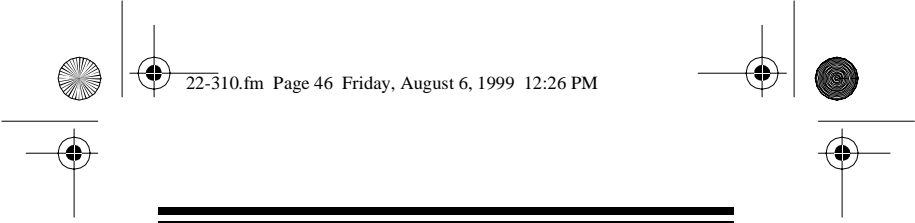
13. Apply the probe tip to the signal source to be measured.

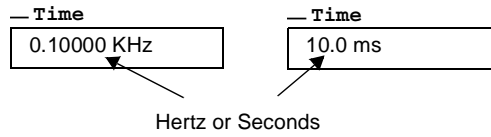14. Turn on the device to be measured. A single waveform appears on the oscilloscope screen.
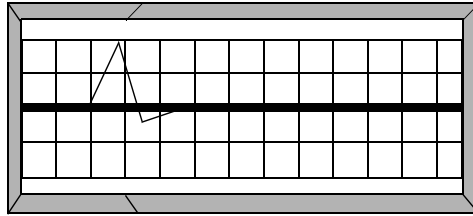
15. Measure the single sweep frequency as follows:

  a. Place the mouse cursor directly over the oscilloscope screen's left vertical cursor. The cursor's shape changes to a cross.

Left Cursor   Right Cursor
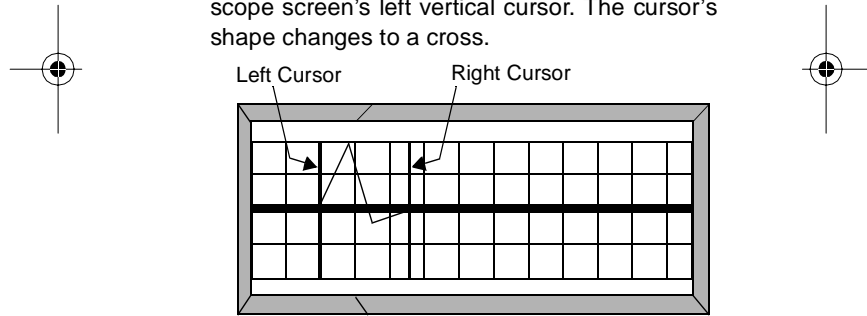
  b. While you press and hold the left mouse button, move the mouse left or right until the screen's left vertical cursor touches the point where the rising edge of the waveform intersects the zero reference line.

  c. Place the computer's mouse cursor directly over the oscilloscope screen's right vertical cursor. The cursor's shape changes to a cross.
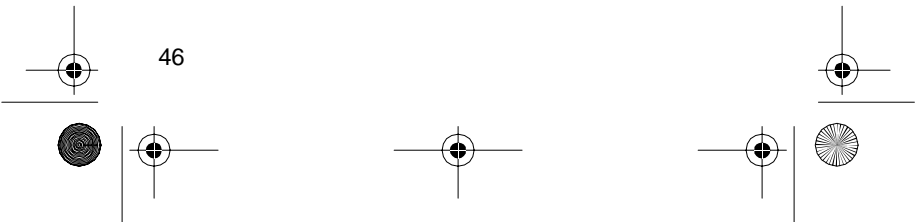
d.While you press and hold the left mouse button, move the mouse left or right until the screen's right vertical cursor touches the point where the next rising edge of the waveform intersects the zero reference line.

e.When you select **HERTZ**, the **─Time** value represents the signal's frequency. When you select **Seconds**, the **─Time** value represents the time between the cursors.

```
─ Time                    ─ Time
0.10000 KHz               10.0 ms
```

Hertz or Seconds

Notes:

• You can click the ⌷ Hz SEC ⌷ tool bar button to toggle between Hertz or Seconds.

• The timebase on the computer's **Timebase** display changes with the grid overlay settings.

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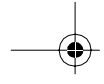
USING THE DVM

The following applications describe how to make basic voltage measurements using the ProbeScope's digital voltmeter (DVM) mode. These applications are not described in detail, but are designed to familiarize you with basic DVM operating techniques.

In digital voltmeter measurements, the measured AC or DC voltage is converted to digital values using an analog-to-digital (A/D) converter.

In the AC mode, the ProbeScope rectifies the AC signal to convert it to DC. The DC is then converted to a digital value by a 6-bit resolution A/D converter, then multiplied by 0.707 to display the RMS value. You must have at least two cycles of a waveform for the Probe-Scope to accurately measure AC DVM values.

Note: The voltmeter function is to be used only for pure AC and DC measurements. Only sine waves are allowed for AC measurements since the ProbeScope does not support true RMS functions. For measuring an AC signal on a DC bias, use the oscilloscope (see "Using the Oscilloscope" on Page 22).
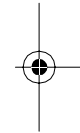
In the DC mode, the DC is directly converted to a digital value by the 6-bit resolution A/D converter. An average of up to 128 recorded values appears on the screen. A negative value is displayed when the average is below the reference line.

Follow these steps to measure a signal's voltage level.

1. Continuously press the Menu button until the **FUNCTION** mode appears on the display.

2. Press the Select button to set the function mode to **DVM,** then press the Menu button again.
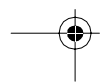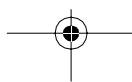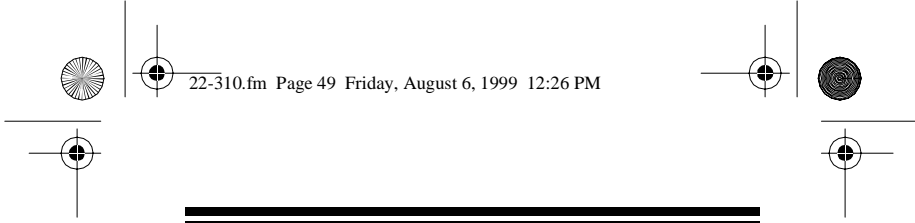
3. Set the input coupling switch to **GND**.

4. Connect the **GROUND** (0 volt) wire to the signal source's ground or reference level.

5. Rotate **Zero Level** to vertically position the trace to a convenient line on the grid overlay.

   Caution: To avoid an overload when measuring AC, make sure the zero line is centered vertically on the grid overlay.

   Note: If the trace is widened by stray interference, ground the probe body near the point being measured. The trace position is the voltage reference line and all voltage measurements are read in respect to this line. (Do not adjust the vertical positioning control after the reference is established.)

6. If it was necessary to ground the tip (see Step 5 note), remove the tip from the ground or reference voltage. This readies the tip so you can use it to make a measurement.

7. Set the input coupling selector to **AC** or **DC** (depending on the voltage you want to measure).

8. Set the input voltage range to the appropriate **1V**, **10V**, or **100V** range scale.

   Cautions:

   • Always set the selector to the highest range when you are not sure of the voltage to be measured.

   • Never exceed 100 Volts AC (peak-to-peak) or DC between the measured test point and ground.
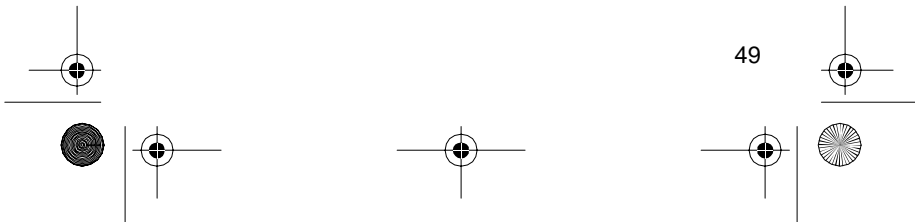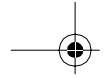
• The maximum AC RMS measurement is (Voltage Range Selection / 2) ¥ 0.707.

9. Click on the DVM icon on the tool bar to display the DVM box.

DVM:

0.0 V AC
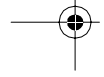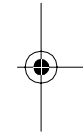
10. Apply the probe tip to the circuit to be tested. The actual voltage appears on the ProbeScope's display and on the monitor's DVM box.

DVM:

3.6 V AC

If you want to freeze the current voltage reading so you can take another measurement reading for comparison, click HOLD on the tool bar.

CARE AND MAINTENANCE

Your Radio Shack ProbeScope V4.1 for Windows/ DOS is an example of superior design and craftsmanship. The following suggestions will help you care for the ProbeScope so you can enjoy it for years.

Keep the ProbeScope dry. If it gets wet, wipe it dry immediately. Liquids might contain minerals that can corrode the electronic circuits.

Handle the ProbeScope gently and carefully. Dropping it can damage circuit boards and cases and can cause the ProbeScope to work improperly.

Use and store the ProbeScope only in normal temperature environments. Temperature extremes can shorten the life of electronic devices and distort or melt plastic parts.

Keep the ProbeScope away from dust and dirt, which can cause premature wear of parts.

Wipe the ProbeScope with a damp cloth occasionally to keep it looking new. Do not use harsh chemicals, cleaning solvents, or strong detergents to clean the ProbeScope.

Modifying or tampering with the ProbeScope's internal components can cause a malfunction and might invalidate your ProbeScope's warranty and void your FCC authorization to use it. If your ProbeScope is not performing as it should, take it to your local Radio Shack store for assistance.

SPECIFICATIONS

Sampling Rates .... 50, 100 ns
.5, 1, 5, 10, 50 ms
.1, .5, 1 ms

DC Band Width .... DC – 5 MHz

AC Band Width ....   100 Hz – 5 MHz

A/D Converter .... 6-Bit resolution

RAM .... 128 Bytes

Input Coupling .... AC, DC, or GND (Ground)

Input Voltage Ranges 1V, 10V, 100V

Note: All voltages measurements are referenced to 0V ground. The effective ranges for AC volt measurements in DVM mode are 0.33V, 3.3V, and 33V since the peak-to-peak voltage must be digitized and converted to the RMS value.

Trigger Definitions .... Auto, Internal, External

Trigger Levels .... Six selectable levels

Note: Level tolerances are dependent on the selected input voltage range: 1V ±.1V, 10V ±3V, 100V ±10V
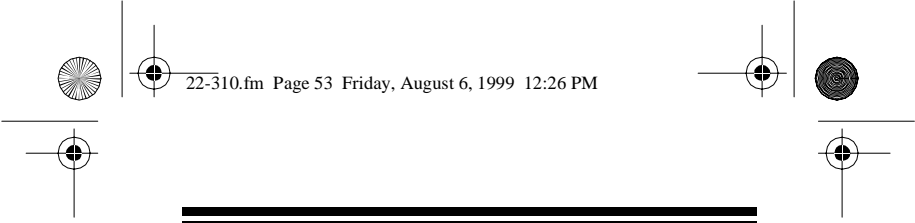
Trigger Modes .... Continuous RUN/SINGLE Cycle

Display .... 16 ¥ 32 dots resolution, LED backlighted

Serial Line .... 19.200 kBaud
7 Data Bits, 1 Stop Bit, No Parity

DVM Accuracy ....±2 to ±5%
(depending on the parameter settings)

Power Supply ....9 – 13V DC
red (+) and black (–) alligator clips

Current Required .... Backlight Off = 12 mA Typical
Backlight On = 85 mA Typical

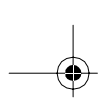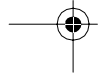Dimensions (HWD) .... $6^1/_2$ ¥ $1^5/_{16}$ ¥ $^3/_4$ in
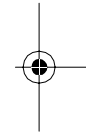(165 ¥ 33 ¥ 19 mm)

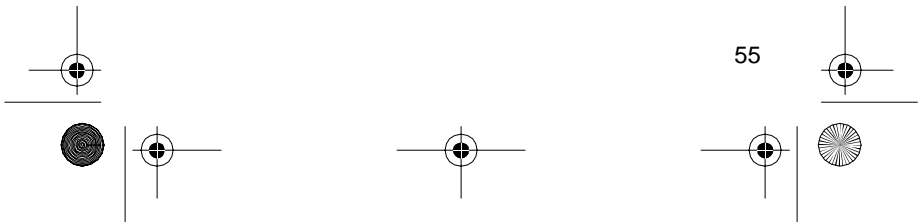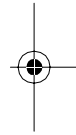Weight .... About 1 lb, 14.4 oz. (86 g)
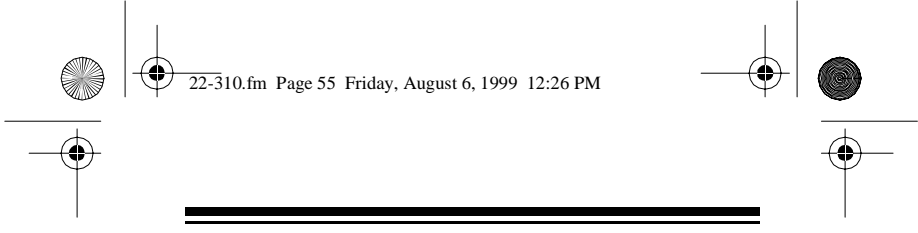
Specifications are typical; individual units might vary.
Specifications are subject to change and improvement
without notice.
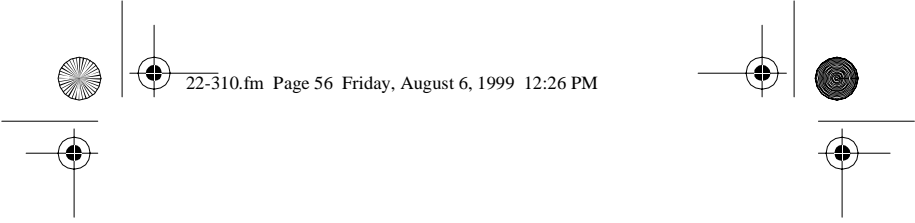
NOTES

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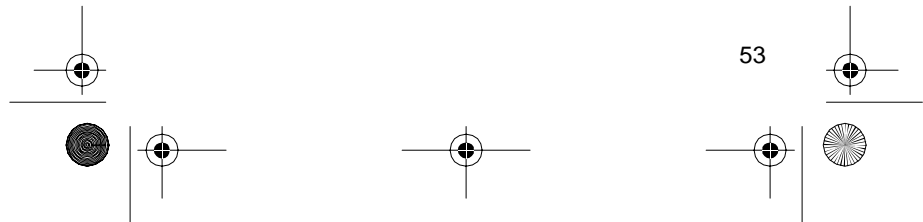
RADIO SHACK LIMITED WARRANTY

This product is warranted against defects for 90 days from date of purchase from Radio Shack company-owned stores and authorized Radio Shack franchisees and dealers. Within this period, we will repair it without charge for parts and labor. Simply **bring your Radio Shack sales slip** as proof of purchase date to any Radio Shack store. Warranty does not cover transportation costs. Nor does it cover a product subjected to misuse or accidental damage. EXCEPT AS PROVIDED HEREIN, RADIO SHACK MAKES NO EXPRESS WARRANTIES AND ANY IMPLIED WARRANTIES ARE LIMITED IN DURATION TO THE DURATION OF THE WRITTEN LIMITED WARRANTIES CONTAINED HEREIN. Some states do not permit limitation or exclusion of implied warranties; therefore, the aforesaid limitation(s) or exclusion(s) may not apply to the purchaser.

This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

We Service What We Sell   *9/94*
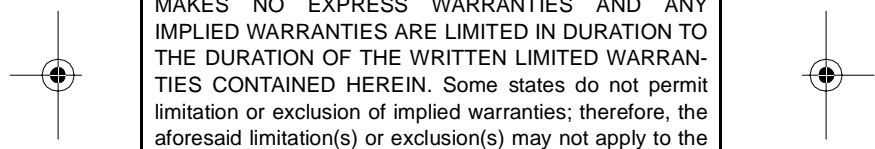
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