
TEK

070-7272-00
Product Group 37

2432A DIGITAL STORAGE OSCILLOSCOPE OPERATORS

*Please Check for
CHANGE INFORMATION
at the Rear of This Manual*

First Printing OCT 1988
Revised NOV 1988

Tektronix[®]
COMMITTED TO EXCELLENCE

Copyright © 1988 Tektronix, Inc. All rights reserved. Contents of this publication may not be reproduced in any form without the written permission of Tektronix, Inc.

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

TEKTRONIX, TEK, SCOPE-MOBILE, and  are registered trademarks of Tektronix, Inc.

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

INSTRUMENT SERIAL NUMBERS

Each instrument has a serial number on a panel insert, tag, or stamped on the chassis. The first number or letter 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:

B000000	Tektronix Inc., Beaverton, Oregon, USA
100000	Tektronix Guernsey, Ltd., Channel Islands
200000	Tektronix United Kingdom, Ltd., London
300000	Sony/Tektronix, Japan
700000	Tektronix Holland, NV, Heerenveen, The Netherlands

First Printing October 1988

Preface

The documentation for the 2432A consists of the following publications:

1 Operators Manual	070-7272-00
1 Users Reference	070-7269-00
1 Programmers Reference Guide	070-7271-00
1 GPIB Pocket Guide	070-7270-00
1 Service Manual (Optional accessory)	070-7273-00

The Operators Manual is the authoritative reference for all operating information. The only exception is information regarding system interfacing and operating this instrument via the GPIB; the Programmers Reference Guide is the primary reference for GPIB operation.

This manual contains seven sections plus appendices. A brief description of each follows.

Section 1

This section introduces you to the instrument. It begins with a description of the instrument and continues with an explanation of how to prepare the instrument for initial start-up. Operating considerations necessary for preventing damage to the scope are also covered. Next, the user gets some “hands-on” experience with the instrument through a “Getting Acquainted” procedure.

Section 2

This is a two-part section. Part one, “Operating Considerations,” details the basic things to be aware of when making measurements. Part two, “Operators Familiarization Procedures,” gives you the opportunity to make some measurements that demonstrate various features while familiarizing you with the scope’s controls and menus. Use of the important Self Calibration feature is also covered.

Section 3

This four-part section provides detailed procedures for making measurements with the scope. They are intended to help you develop your own methods for your specific measurement requirements.

The first part of the section, "Applications," details the more familiar graticule measurements of signal amplitude and time period. Use of the Vertical and Horizontal Display modes (including delay-time measurements) is also covered in part one.

Part two, "Special Applications," describes use of the versatile cursors for making highly accurate measurements of voltage, time, and frequency. It includes an application for the combined A*B trigger source.

The third part, "Storage Applications," describes the various storage acquisition modes and their uses.

The final section, "Extended Features Applications," outlines use of the Auto Setup, AutoStep Sequencer, and MEASURE features.

Section 4

This section contains check and adjustment procedures the operator can use to ensure the accuracy of measurements.

Section 5

This is the reference section that describes instrument features. It illustrates the locations of the controls, connectors, and indicators and describes their functions. A listing of the control menus, at the rear of the section, includes information about their use.

Section 6

This section contains tables of the electrical, environmental, and mechanical characteristics of the instrument. An introductory summary of the instrument's capabilities precedes the specification tables. A dimensional drawing of the instrument is included at the end of the section.

Section 7

This section contains information about available instrument options, including operating instructions for the Video Option and the Word Recognizer Probe. It also contains a list of the standard instrument accessories and a partial list of the recommended optional accessories.

Appendix A

The Extended Functions menus and the internal calibration and diagnostics capabilities of the scope are described. For the operator's information, a table at the rear of the appendix lists the Extended Diagnostics test codes and abbreviated names.

Appendix B

This appendix contains supplemental reference tables and information.

Appendix C

This appendix discusses special considerations for using the MEASURE feature to automatically extract and measure waveform parameters. It includes a table that lists and explains the error and warning messages issued by MEASURE.

Contents

	<i>Page</i>
Preface.....	i
Illustrations	xi
Tables	xii
Operators Safety Summary	xiii
1 <i>General Information</i>	
Introduction.....	1-1
Product Overview	1-1
Preparation For Use	1-3
Safety	1-3
Line Voltage Selection	1-3
Line Fuse.....	1-4
Power Cord	1-7
Instrument Cooling.....	1-7
Start-Up.....	1-8
Power-Down.....	1-9
Repackaging For Shipment	1-10
“Getting Acquainted” Procedure.....	1-11
2 <i>Operation</i>	
Operating Considerations.....	2-1
Graticule	2-1
Time and Voltage Measurements.....	2-2
Acquiring Data.....	2-3
Grounding.....	2-4
Signal Connections	2-4
Probes	2-4
Coaxial Cables	2-5
Input Precharging.....	2-6
External Triggering.....	2-6

2 Operation (cont)

Operators Familiarization Procedures.....	2-7
Introduction	2-7
Readout Display.....	2-7
Front-Panel Controls.....	2-7
Familiarization Procedures.....	2-9
Getting a Display.....	2-9
Front-Panel Setup.....	2-11
Storing Front-Panel Setups	2-14
Performing SELF-CALibration	2-16
Using the SEC/DIV Control and a Horizontal Graticule Measurement.....	2-17
Using CH1 Controls and a Vertical Graticule Measurement.....	2-18
Using SAVE and DISPLAY REF Storage Modes.....	2-19
Using Dual-Channel Displays	2-22
Review of ENVELOPE and AVG (Average) ACQUIRE Modes	2-23
Using SINGLE SEQ Trigger Mode.....	2-24
Using The Cursors	2-25
Volts Cursors.....	2-25
V@T Cursors	2-27
SLOPE Cursors.....	2-28
TIME Cursors	2-29
1/TIME Cursors	2-30
DELAY Features	2-32
DELAY by TIME.....	2-32
DELAY by EVENTS	2-34
Extended Features.....	2-36
Using AUTOsetup	2-37
Using MEASURE	2-39
Using PRGM (AutoStop)	2-44

3 Applications

General Applications	3-2
Voltage Measurements	3-2
Peak-to-Peak Voltage	3-2
Instantaneous DC Voltage Level.....	3-3
ADD Mode Measurements	3-4
Noise Reduction and Unwanted Signal Cancellation	3-6
MULT Mode Measurements.....	3-9
TIME AND FREQUENCY Measurements—Non-Delayed.....	3-12
Delay Time Measurements and Applications	3-14
DELAY TIME Mode As A Magnifier	3-14
Other Delay Applications	3-17
Δ Delay Time and Frequency Measurements	3-18
Delay By Events Measurements	3-21
General Information for Delay Acquisition Usage	3-23

3 Applications (cont)

Special Applications.....	3-24
Cursor Measurements	3-24
Voltage Measurements	3-24
Delta Voltage Measurements	3-25
Ratio Between Two Voltages	3-26
Absolute Voltage Cursor Measurements	3-29
Time and Frequency Measurements	3-30
Δ Time Cursor Measurements	3-31
Ratio Between Two Time Periods.....	3-34
Absolute TIME Cursor Measurements	3-35
Voltage Coupled to Time Cursors (V@T)	3-37
Slope Measurements	3-40
Special Units for Coupled Cursors	3-42
A*B Trigger Source Application.....	3-43
Storage Applications	3-46
Acquire Modes	3-46
NORMAL Mode	3-46
AVG (Average) Mode	3-46
ENVELOPE Mode	3-49
ROLL Mode	3-50
REPET Mode	3-51
SAVE Storage Mode	3-51
SAVEREF SOURCE and DISPLAY REF	3-54
SAVE ON Δ Mode	3-56
Extended Features Applications.....	3-61
AUTOsetup.....	3-62
“Quick and Dirty” Display of a Signal	3-62
“Quick and Dirty” Displays of Parameters.....	3-62
Dual-Channel Auto Setup Displays	3-64
Considerations for Using Auto Setup.....	3-65
MEASURE.....	3-67
SNAPSHOT, A Quick Measurement of Waveform Parameters.....	3-67
Interpreting the Display	3-70
Characterization of the Leading Edge of a Pulse	3-71
Parameter Measurements Using the Continuous-Update Mode.....	3-74
Delay Measurements Between Signals.....	3-77
AUTOSTEP SEQUENCER (PRGM).....	3-85
Storage of a Single Front-Panel Setup	3-85
Storage of a Sequence of Front-Panel Setups.....	3-86
Using a Sequence	3-88
Interaction of Sequencer with Acquisition Modes.....	3-89

4 *Checks and Adjustments*

Introduction	4-1
Starting Setup.....	4-1
Trace Rotation Adjustment	4-2
Focus and Astigmatism Adjustment	4-2
Vertical Gain Check	4-3
Horizontal Gain Check.....	4-3
Probe Low-Frequency Compensation.....	4-4

5 *Controls, Connectors and Indicators*

CRT Display, Menu Buttons and Power	5-1
Vertical Controls	5-6
Cursors	5-13
External Interface	5-20
General Purpose Interface Bus	5-22
Horizontal Controls.....	5-29
Delay Controls	5-31
Trigger Controls	5-34
Storage System	5-44
Extended Features.....	5-56
Rear Panel	5-79
System Menus.....	5-82

6 *Performance Characteristics*

Introduction	6-1
Vertical System.....	6-2
Horizontal System.....	6-2
Trigger System.....	6-2
Cursor Measurement.....	6-4
Waveform Acquisition.....	6-4
Storage and I/O	6-5
Extended Features.....	6-6
Performance Conditions	6-8
Recommended Adjustments Schedule.....	6-8

7 *Options and Accessories*

Options Descriptions	7-1
Options A1-A5—International Power Cords	7-2
Option 1R—Rackmounting	7-2
Option 03—Word Recognizer Probe	7-3
Option 05—Video Option	7-3
Option 11—Probe Power	7-3

7 Options and Accessories (cont)

Option Operating Information.....	7-4
Video Options.....	7-4
Introduction.....	7-4
Video Option Accessories.....	7-4
Video Option Specifications.....	7-4
General Operation	7-5
Setting Up the Video Option.....	7-5
Setting a Line Number	7-8
System-M/Nonsystem-M Selection	7-9
Special Measurements.....	7-9
Identifying Fields, Frames, and Lines in 525/60 and 625/50 TV.....	7-10
Basic Applications	7-11
Initial Setup	7-12
Signal Input Coupling.....	7-15
Word Recognizer Probe Options.....	7-16
Word Probe Setup	7-17
Basic Application.....	7-18
Accessories.....	7-19
Standard Accessories.....	7-19
Rackmounting Accessories	7-19
Optional Accessories	7-20

A Appendix A

Extended Functions.....	A-1
SPECIAL Functions	A-1
SYSTEM Functions	A-1
PREFLT ON/OFF.....	A-2
PANEL.....	A-2
MISC	A-2
AUTO PROBE.....	A-3
VIDEO OPT	A-4
CAL/DIAG Functions	A-5
Internal Diagnostic Routines.....	A-5
Self Diagnostics.....	A-5
Power-on Self Diagnostics Test Failure	A-5
Extended Diagnostics	A-8
Service Routines	A-8
Internal Calibration Routines	A-9
Self Calibration	A-9
Extended Calibration	A-9
Calibration/Diagnostics Operation	A-10
Self Calibration.....	A-11
Extended Calibration	A-11
Power-On Self Diagnostics	A-12
Front-Panel Self Diagnostics	A-12
Extended Diagnostics.....	A-12
UP/DOWN Arrows	A-13
RUN/SEL.....	A-14
MODE.....	A-14
HALT	A-14

A Extended Calibration (cont)

GPIB Operation	A-15
Self Calibration.....	A-15
Extended Calibration	A-16
Self Diagnostics	A-16
Extended Diagnostics.....	A-16

B Appendix B

VOLTS/DIV Range With Attenuator Probes	B-1
Calibrator Frequency	B-2
Averaging SNIR.....	B-3
REPETITIVE Acquisition	B-3
SMOOTH	B-4
Variable HOLDOFF.....	B-4
Trigger LEVEL Range and Resolution.....	B-6
Auto Triggering and Auto Leveling	B-7
B Trigger Source	B-8
Trigger Position	B-9
Delay Time and Delay Time Resolution.....	B-10
Trigger Status Indicators.....	B-13
Waveform Display Summary.....	B-14
STACK REF Storage Operation	B-15
SAVE ON DELTA Operation.....	B-16
Front-Panel Settings for INIT PANEL.....	B-17
Front-Panel Settings for Auto Setup	B-22

C Appendix C

Introduction.....	C-1
Parameter Extraction from the Waveform.....	C-1
Overview	C-1
BASE-TOP Determination	C-2
MIN/MAX Method	C-2
HISTOgram Method.....	C-2
CURSOR Method	C-3
Level Calculations	C-4
Determination of Time-Reference Points	C-8
Time-Reference Points Search Procedure.....	C-8
Calculation of the Waveform Parameters	C-9
Intersection of MEASURE with Acquisition Modes	C-13
ENVELOPE Mode	C-13
AVERAGE Mode.....	C-14
REPET Mode	C-14
SAVEd Expanded Waveforms.....	C-14
Vertical Expansion	C-15
SMOOTH Acquisition Mode	C-15
ROLL Acquisition Mode.....	C-15
Glossary of Parameter Extraction Terms	C-16
Warning and Error Messages for MEASURE.....	C-17
ERROR Messages	C-17
WARNING Messages	C-20

Illustrations

Figure	Page
1-1 LINE VOLTAGE SELECTOR, fuse, and power cord receptacle	1-5
2-1 Graticule measurement markings	2-1
2-2 Readout display locations	2-8
2-3 SELECT menu and menu control buttons	2-11
3-1 Sine wave peak-to-peak voltage	3-3
3-2 Instantaneous DC voltage levels on a waveform	3-5
3-3 Cancellation of common-mode noise for differential signals	3-6
3-4 Cancellation of an unwanted component in a signal	3-8
3-5 Rise time of a square wave (time duration)	3-13
3-6 DELAY TIME used as a positionable magnifier	3-16
3-7 Δ DELAY TIME used to measure the period of a square wave	3-20
3-8 Delay and Δ Delay acquisitions as displayed for CH1, CH2, and ADD (or MULT) VERTICAL MODE	3-21
3-9 Measuring a 3.5-V sine-wave signal using VOLTS cursors	3-26
3-10 Measuring the ratio between the amplitudes of two sine-wave signals	3-28
3-11 Voltage measurement of a step on a stair-case signal using the VOLTS cursor function in the ABS mode	3-30
3-12 Time measurements using TIME Cursor function and modes	3-33
3-13 Time measurement of an event relative to the Record Trigger	3-36
3-14 VOLTS coupled to TIME cursors displayed on a triangle wave	3-36
3-15 V@T measurements on triangle-wave signals	3-39
3-16 High resolution measurement of the frequency of a sine-wave signal	3-41
3-17 Slope measurement on a triangle-waveform	3-42
3-18 Effect of signal averaging on a noisy square wave	3-48
3-19 Using the SAVEREF function with ENVELOPE mode to monitor and save a square wave	3-60
3-20 AUTOsetup for EDGE (rising)	3-72
3-21 SNAPSHOT of a pulse's rise time	3-73
3-22 Continuous-Update Mode for MEASURE	3-76
3-23 Dual-Channel Auto Setup in VIEW mode	3-78
3-24 DELAY Measurement between a pulse and a gate	3-81
3-25 DELAY measurement locations on waveforms	3-82
3-26 Controlling measurement location with WINDOW mode	3-83
4-1 Probe low-frequency compensation	4-5
5-1 POWER, DISPLAY controls, and MENU buttons	5-2
5-2 STATUS readout display	5-5
5-3 Vertical controls and connectors	5-14
5-4 Typical cursor displays	5-15
5-5 External interface	5-20
5-6 Horizontal and delay controls	5-32
5-7 Storage and trigger controls	5-55
5-8 AUTO, PRGM, and MEASURE buttons	5-59
5-9 Event order for sequences	5-72
5-10 Rear-panel controls and connectors	5-79
5-11 GPIB-connector pin arrangement	5-82

Illustrations

Figure	Page
6-1 Dimensional drawing	6-35
7-1 Composite video signal with and without TV clamping	7-16
A-1 EXTENDED DIAGNOSTICS Menu	A-13
B-1 Amplitude response for smooth function	B-4
B-2 RTRIG versus horizontal display modes	B-12
C-1 Parameter extraction using HISTOgram method	C-7
C-2 Parameter extraction using MIN/MAX method	C-7

Tables

Table	Page
1-1 Voltage, Fuse, and Power-Cord Data	1-6
2-1 Equipment Required	2-36
3-1 Delay Displays versus Vertical MODE	3-19
3-2 SNIR vs Number of Acquisitions	3-47
3-3 Vertical Expansion Factors	3-52
3-4 Horizontal Expansion Factors	3-53
5-1 Approximate Exponential-Averaging Time Constants at 10 Hz	5-48
5-2 Control Menus and Displays	5-83
6-1 Electrical Characteristics	6-9
6-2 Environmental Characteristics	6-26
6-3 Mechanical Characteristics	6-29
6-4 Video Option 05 (TV Trigger) Electrical Characteristics	6-31
A-1 Calibration and Diagnostics Codes and Names	A-17
B-1 VOLTS/DIV Readout Switching With Coded Probes	B-1
B-2 Calibrator Frequency and Period for Each A SEC/DIV Setting	B-2
B-3 Signal-to-Noise Improvement Ratio Versus Number of Averages	B-3
B-4 Repet Acquisitions Required To Complete a Single Sequence	B-3
B-5 Variable Trigger Holdoff	B-5
B-6 Trigger Resolution	B-6
B-7 Auto Triggering and Auto-Leveling Intervals	B-7
B-8 B Trigger Source Menu Versus B Trigger Mode	B-8
B-9 RTRIG Point versus Trigger Position Menu Selection	B-9
B-10 Maximum B SEC/DIV Delay Time and Resolution	B-10
B-11 TRIG'D, READY, and ARM Indicator Status	B-13
B-12 Display Priority Versus Display Mode	B-14
B-13 REF Storage Operation versus Horizontal and Vertical Modes	B-15
B-14 SAVE ON DELTA Comparisons	B-16
B-15 INIT PANEL States	B-17
B-16 Front-Panel Settings After an Auto Setup	B-22
C-1 Definition of Parameters	C-9
C-2 Error Messages for MEASURE	C-17
C-3 Warning Messages for MEASURE	C-20