# User Manual

Tektronix

# TDSJIT1V2
# Jitter Analysis Measurements Application

## 071-0875-00

This document supports software version 1.2.0
and above.

**www.tektronix.com**

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

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# General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

*Only qualified personnel should perform service procedures.*

While using this product, you may need to access other parts of the system. Read the *General Safety Summary* in other system manuals for warnings and cautions related to operating the system.

## To Avoid Fire or Personal Injury

**Connect and Disconnect Properly.** Do not connect or disconnect probes or test leads while they are connected to a voltage source.

**Observe All Terminal Ratings.** To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

**Do Not Operate With Suspected Failures.** If you suspect there is damage to this product, have it inspected by qualified service personnel.

## Symbols and Terms

**Terms in this Manual.** These terms may appear in this manual:

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

***CAUTION.*** *Caution statements identify conditions or practices that could result in damage to this product or other property.*

**Terms on the Product.** These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

**Symbols on the Product.** The following symbol may appear on the product:

CAUTION Refer to Manual

# Preface

This manual contains operating information for the TDSJIT1V2 Jitter Analysis Application. The manual consists of the following chapters:

- The *Getting Started* chapter briefly describes the TDSJIT1V2 Jitter Analysis Application, lists oscilloscope compatibility, and provides installation instructions.
- The *Operating Basics* chapter covers basic operating principles of the application and includes a tutorial that teaches you how to set up the application to acquire a waveform, take measurements, and view the results.

  To show you how to operate the application using GPIB commands, this chapter includes a simple GPIB program.
- The *Reference* chapter includes a diagram of the menu structure and descriptions of parameters.
- The *Measurement Algorithms* appendix contains information on measurement guidelines and on how the application takes the measurements.
- The *GPIB Command Syntax* appendix contains a list of arguments and values that you can use with the GPIB commands and their associated parameters.
- The *Error Codes* appendix contains a list of error codes, descriptions of the errors, and possible solutions to correct the problem.
- The *Example Program to Copy Large Files* appendix contains an example of a GPIB program you can use to transfer large files to a personal computer.

## Related Documentation

The user manual for your oscilloscope provides general information on how to operate the oscilloscope.

Programmer information in the online help for your oscilloscope provides details on how to use GPIB commands to control the oscilloscope. You can also download the tds6prog.zip file (online help) with examples from the Tektronix web site. The file can be used for all supported oscilloscopes. Refer to *Updates Through the Web Site* on page 1–2 for information on how to download the file.

## Conventions

This manual uses the following conventions:

- This manual refers to the TDSJIT1V2 Jitter Analysis Application as the TDSJIT1V2 application or as the application.
- When steps require that you make a sequence of selections using front-panel controls and menu buttons, an arrow ( → ) marks each transition between a front-panel button and a menu, or between menus. Names that are for a main menu or side menu item are clearly indicated: Press VERTICAL MENU → Coupling (main) → DC (side) → Bandwidth (main) → 250 MHz (side).

## Contacting Tektronix

| | |
|---|---|
| **Phone** | 1-800-833-9200***** |
| **Address** | Tektronix, Inc.<br>Department or name (if known)<br>14200 SW Karl Braun Drive<br>P.O. Box 500<br>Beaverton, OR 97077<br>USA |
| **Web site** | www.tektronix.com |
| **Sales support** | 1-800-833-9200, select option 1***** |
| **Service support** | 1-800-833-9200, select option 2***** |
| **Technical support** | Email: techsupport@tektronix.com<br>1-800-833-9200, select option 3*****<br>1-503-627-2400<br>6:00 a.m. – 5:00 p.m. Pacific time |

*** This phone number is toll free in North America. After office hours, please leave a voice mail message.**
**Outside North America, contact a Tektronix sales office or distributor; see the Tektronix web site for a list of offices.**

# Getting Started

# Product Description

The TDSJIT1V2 Jitter Analysis Application is a Java™-based application that enhances basic capabilities of some Tektronix oscilloscopes.

The application provides jitter analysis measurements, can display the statistical results of up to six measurements, can display the results as plots, can save the results to a data log file, and can save the worst case waveforms to files.

Figure 1–1 shows an example of a Clock Period measurement displayed as a Histogram plot.

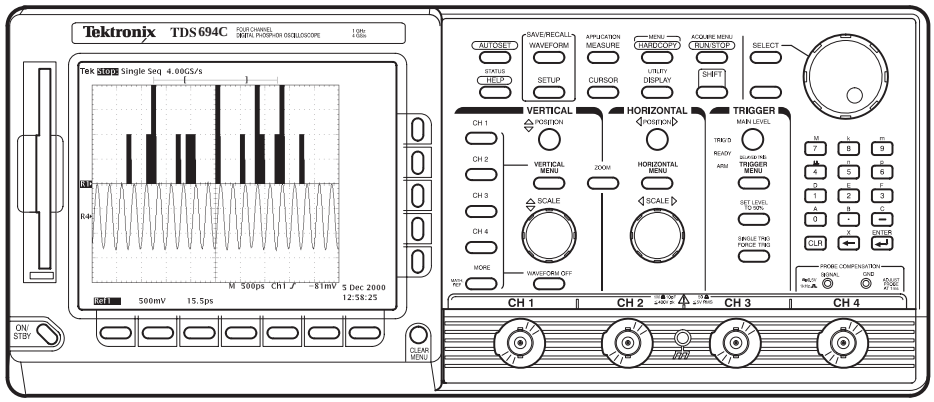



**Figure 1–1: TDSJIT1V2 Jitter Analysis Application**

## Compatibility

The Jitter Analysis Application V 1.2.0 and above is compatible with the TDS694C oscilloscope with firmware version 6.2 and above, and with TDS784D and TDS794D oscilloscopes with firmware version 6.6e and above, or 7.2e and above depending on the acquisition board in the oscilloscope.

For information on how to get the current firmware, contact your local Tektronix distributor or sales office.

For a current list of compatible oscilloscopes, see the Software and Drivers category in the Tektronix, Inc. web site (www.tektronix.com).

## Requirements and Restrictions

The TDS Run-Time Environment V1.2.0 or above must be installed on the oscilloscope to operate the TDSJIT1V2 application and use GPIB commands.

## Updates Through the Web Site

You can find information about this and other applications at the Tektronix, Inc. web site. Check this site for application updates and for other free applications.

To install an application update, you will need to download it from the web site to a hard disk, copy it to a blank DOS-formatted floppy disk, and then install it on your oscilloscope.

***NOTE****. More information about changes to the application or installation is in a* Readme.txt *file on the web site. You should read it before you continue.*

To copy an application from the web site, follow these steps:

1. Access www.tekrronix.com/Measurement/Support/Scopes.
2. Scroll through the files to the application that you want, select the file, and download it to your hard disk drive. If necessary, unzip the file.

***NOTE****. To ensure that the files were downloaded successfully, always unzip the files on a hard disk before copying them to a floppy disk.*

3. Copy the application from the hard disk to a blank, DOS-formatted floppy disk. Only copy one application on to one floppy disk.
4. Follow the *Installing the Application* procedure on page 1–3.

## Accessories

There are no standard accessories for this product other than this manual.

# Installation

This section contains information on the following tasks:

- Installing the application
- Deskewing probes and channels
- Connecting to a system under test

## Installing the Application

The TDSJIT1V2 floppy disk contains the TDSJIT1V2 Jitter Analysis Application. You can download updates, if any, from the Tektronix ftp site through a web browser.

***NOTE.*** *To operate the TDSJIT1V2 application, the TDS Run-Time Environment V1.2.0 or above must be installed on the oscilloscope.*

To install the application from the floppy disk to your oscilloscope, follow these steps:

**1.** Power off the oscilloscope.

***NOTE.*** *Additional information about the application or installation is located in a* Readme.txt *file on the floppy disk. You should insert the floppy disk into a DOS-based personal computer and read the* Readme.txt *file before you continue.*

*If you are updating the application, the* Readme.txt *file on the Tektronix ftp site supercedes the* Readme.txt *file on the TDSJIT1V2 floppy disk.*

**2.** Insert the disk in the floppy disk drive, and power on the oscilloscope.

***NOTE.*** *To verify that the TDS Run-Time Environment V1.2.0 or above is installed, watch for the abbreviated name, RTE, and version number to appear at the top of the display when you power on the oscilloscope. If they do not appear, contact your local Tektronix sales office.*

After performing the power-on selftest, the oscilloscope automatically begins the installation procedure.

As the application loads from the disk, the oscilloscope displays a clock icon to indicate that it is busy. Also, the floppy disk drive LED is on, indicating activity. If the clock icon continues to display after the floppy disk LED has gone out, a problem has occurred with the installation. Repeat the above procedure. If the problem persists, contact your Tektronix representative.

When the installation is complete, an Installation Complete message displays.

**3.** Remove the floppy disk, and cycle the power to the oscilloscope.

## Deskewing the Probes and Channels

To ensure accurate results for two-channel measurements, it is important to first deskew the probes and oscilloscope channels before you take measurements from your system under test (SUT). Deskewing is where the oscilloscope adjusts the relative delay between signals to accurately time correlate the displayed waveforms.

***NOTE.*** *To produce good deskew results, you should connect the probes to the fastest signal in your SUT.*

The application includes an automated deskew utility that you can use to deskew any pair of oscilloscope channels. The following procedure describes how to deskew two channels. Channel 1 (and the probe connected to it) is the reference point used to deskew channel 2. The steps to deskew the third and fourth channels are the same.

***WARNING.*** *To avoid electric shock, you must ensure that power is removed from the SUT before attaching probes to it. Do not touch exposed conductors except with the properly rated probe tips. Refer to the probe manual for proper use.*

To deskew a pair of probes and oscilloscope channels, follow these steps:

**1.** Connect similar probes to CH 1 and CH 2 on the oscilloscope.

**2.** Connect the probes to the fastest signal in your SUT.

**3.** To set up the oscilloscope, press the AUTOSET front-panel button.

Figure 1–2 shows an example of signal path skew found in similar probes.

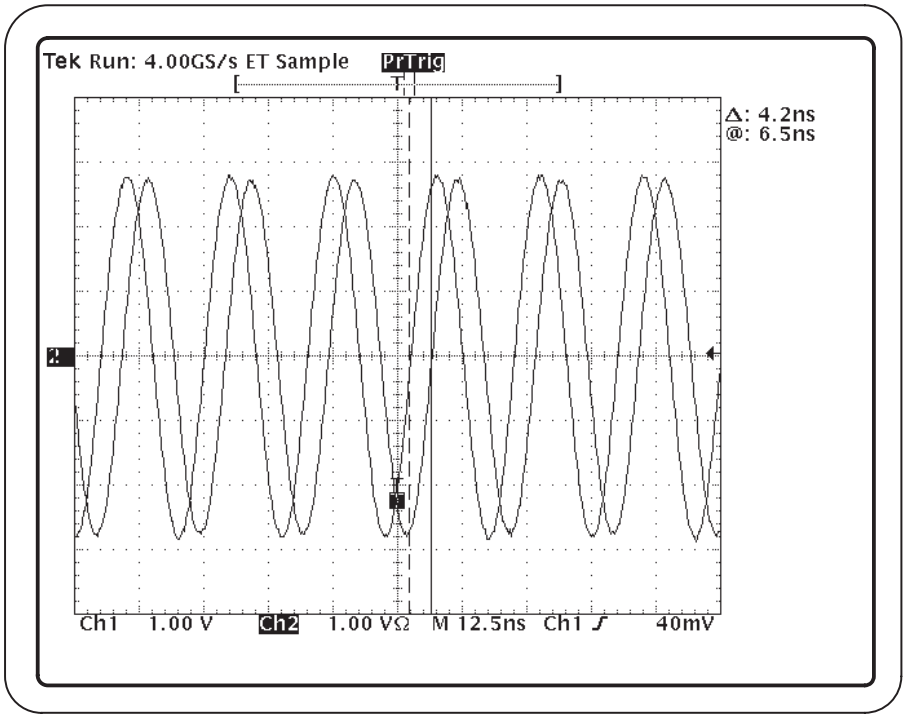



**Figure 1–2: Typical signal path skew**

4. Start the application as described on page 2–30.
5. Press Inputs (main) → Main (side) → Source (side) and select Ch1. The waveform displayed as the source for the Main Input is the reference point to which the remaining channels are deskewed.
6. Press Vertical Autoset (side). Figure 1–3 shows the results of a the Vertical Austoset.

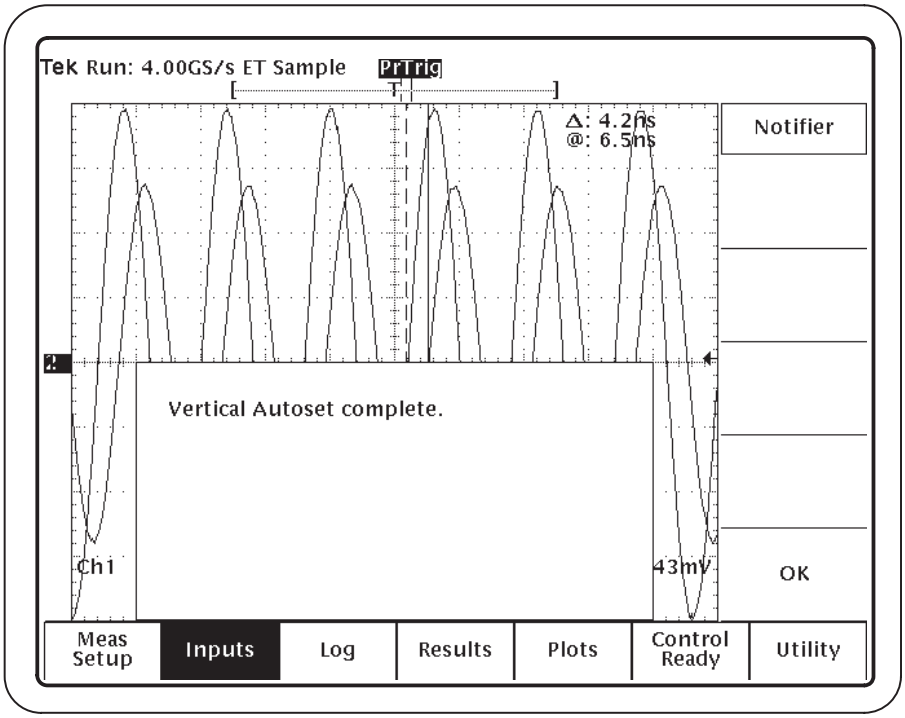



**Figure 1–3: Vertical Autoset complete**

7. Press OK (side).
8. Press Done (side).
9. Press 2nd (side) → Source (side) and select Ch2. The waveform displayed as the source for the 2nd Input is the channel to be deskewed.
10. Press Vertical Autoset (side) and then OK (side).
11. Press – more – 1 of 2 (side) → Deskew ... (side). Figure 1–4 shows how to access the Deskew menu. Figure 1–5 shows the Deskew menu.

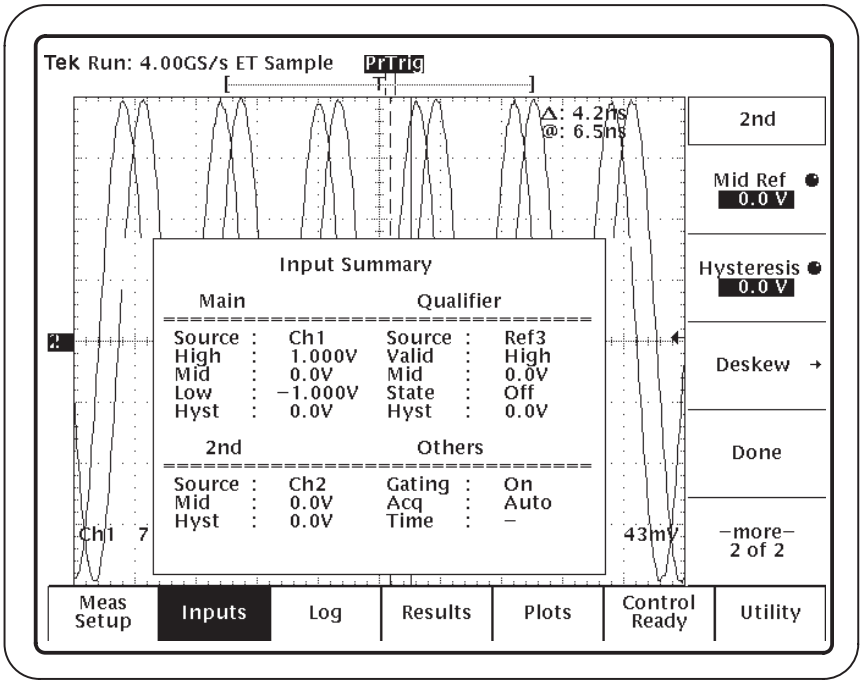



**Figure 1–4: Accessing the Deskew utility**

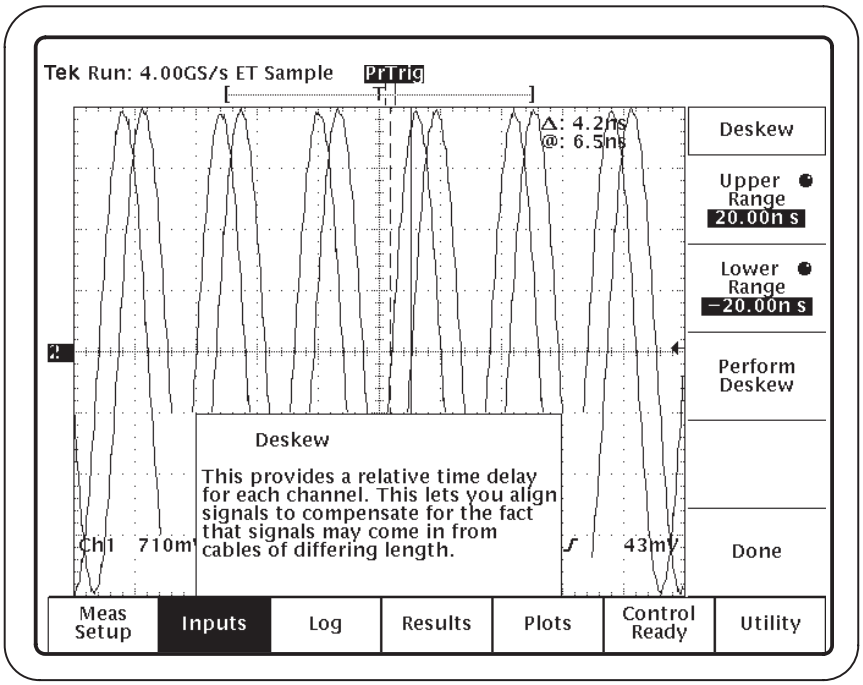



**Figure 1–5: The Deskew menu**

**12.** Enter appropriate values for the Upper Range and the Lower Range side menu items.

**13.** To start the deskew utility, press Perform Deskew (side).

Figure 1–6 shows an example of the utility when it is finished.

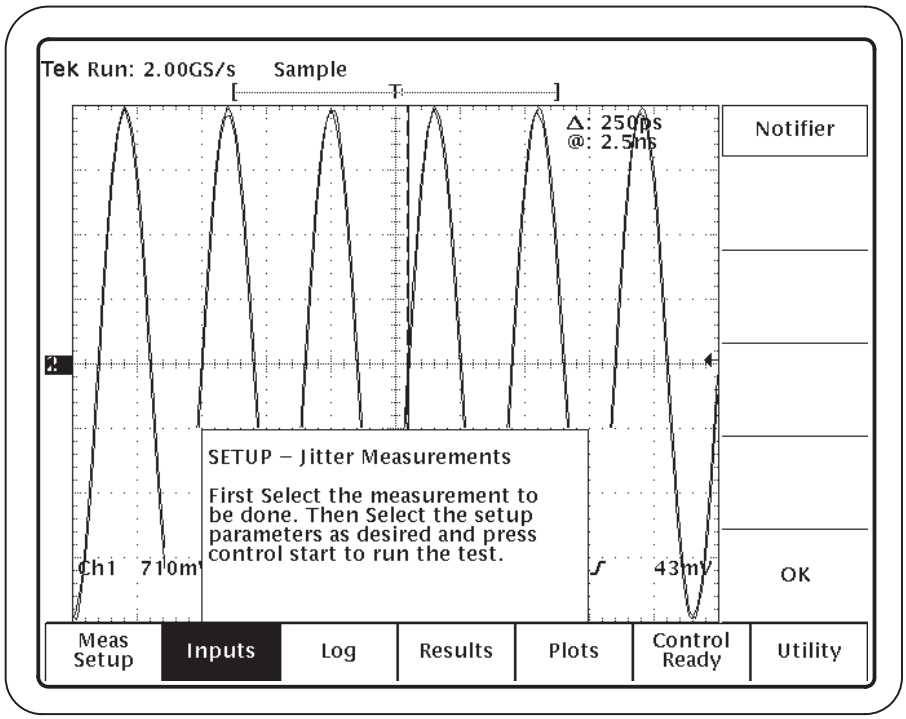



**Figure 1–6: Deskewing complete**

**14.** Press OK (side).

Figure 1–7 shows an example of using the oscilloscope V Bar cursors to measure the adjusted skew. In this example, the skew between channels 1 and 2 was reduced to 320 ps.

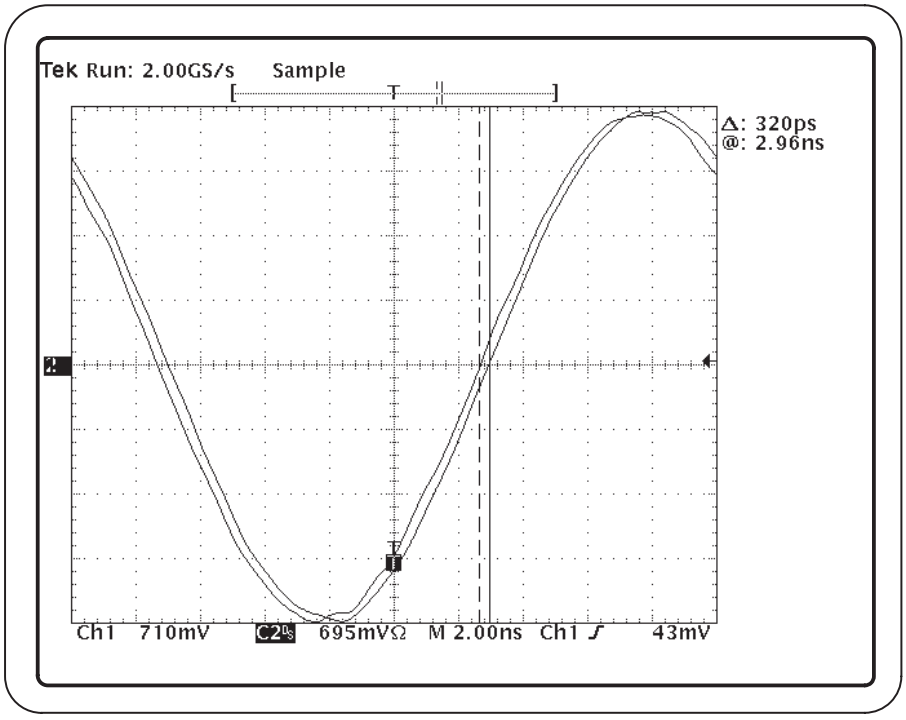



**Figure 1–7: Adjusted skew**

**15.** Press the SHIFT, and then the APPLICATION front-panel menu button to return to the application.

**16.** Do not change the Main Input Source channel, and deskew the remaining channels if you will be using them to take jitter measurements.

## Connecting to a System Under Test

Although you can use any compatible probes to connect between your SUT (system under test) and oscilloscope, Tektronix P6330 3 GHz Differential probes and P6249 4 GHz Differential probes are recommended. One connection is usually to a clock signal.

The General, Clock, and Data measurements require one input waveform. The Clock-Data and the Ch-Ch measurements require two input waveforms.

Table 1–1 shows the default channel-to-waveform and reference waveform-to plot assignments. You can change the assignments to match your configuration.

**Table 1–1: Default waveform assignments**

| Channel or reference | Waveform assignment |
|---|---|
| Ch 1 | Main input waveform, such as a clock signal |
| Ch 2 | Second (2nd) input waveform |
| Ch 3 | Qualifier input waveform |
| Ref1 | Histogram plot format for the first measurement |
| Ref2 | Time Trend plot format for the first measurement |
| Ref3 | Cycle Trend plot format for the first measurement |
| Math1 | Spectrum plot format for the first measurement |

***WARNING.*** *To avoid electric shock, you must ensure that power is removed from the SUT before attaching probes to it. Do not touch exposed conductors except with the properly rated probe tips. Refer to the probe manual for proper use.*

Power down the SUT before connecting the probes to it.

# Operating Basics

# Basic Operations

This section contains information on the following topics and tasks:

- Application interface
- Using basic oscilloscope functions
- Setting up the application
- Taking measurements
- Warning messages
- Analyzing the results
- Saving the results to a file
- Importing a data log file
- Saving and recalling setups
- Exiting the application

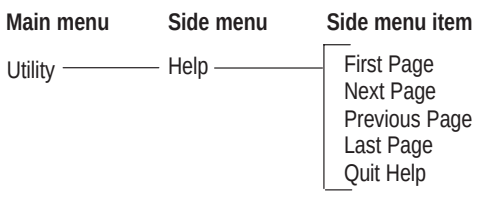
## Application Menu Structure

There are two types of menus in the application menu structure: main menus and side menus. Some side menus contain common items as shown in Table 2–1.

### Main and Side Menus

The main menu names appear in the bottom of the display, and the side menu names appear on the right side of the display. To see the complete application menu structure, refer to Figure 3–1 on page 3–1.

When you press the front-panel button associated with a main menu, the side menu changes. In many cases, when you press a side menu, new side menu items appear. As an example, the next figure shows you how to access the Help selections through the main Utility menu and the Help side menu.



### Common Menu Items

Table 2–1 lists common side menu items.

**Table 2–1: Common menu items**

| Menu item | Description |
|---|---|
| Cancel | Returns to the previous menu without performing the operation specific to the current menu |
| Done | Indicates that you are through making changes to that set of side menus; the application returns to the previous menu |
| OK | Confirms an action |
| –more– x of y | Scrolls to another page of a menu where x is the current page and y is the total number of pages |

### Utility Menus

Table 2–2 lists the Utility menus.

**Table 2–2: Utility menus**

| Utility name | Description |
|---|---|
| Help | Accesses the online help pages and displays useful information on the application |
| Exit | Exits the application |
| Display Options | Accesses other menus where you can change display settings, such as whether the dialog box is opaque or transparent |
| Save/Recall Setup | Accesses the save and the recall menus for application setups |

## Using Basic Oscilloscope Functions

You can use the Utility menu to access help information about the application. You can also use other oscilloscope functions and easily return to the application.

### Using Local Help

The application includes local help information about the measurements modes, with some explanation of the individual controls.

To display the local help, follow these steps:

1. Press Utility (main) → Help (side).
2. Use the side menu buttons to navigate through the help.

### Returning to the Application

You can easily switch between the TDSJIT1V2 application and other oscilloscope functions.

To access other oscilloscope functions, press the desired front-panel control. To return to the application, press the SHIFT and then the APPLICATION front-panel menu buttons as shown in Figure 2–1.

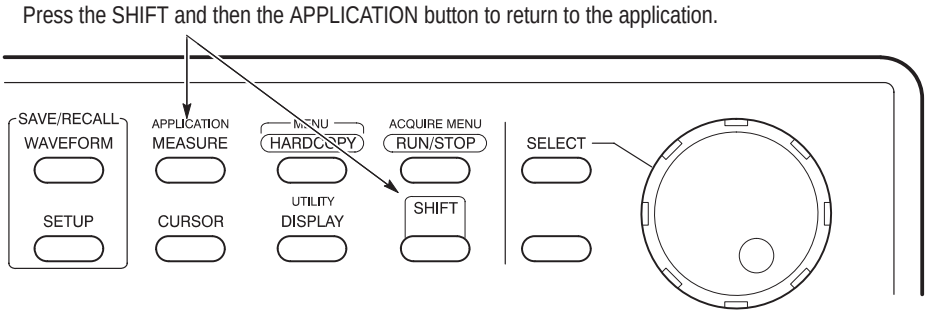



**Figure 2–1: Returning to the application**

**Default Directories.** Table 2–3 lists default directory names and their use.

**Table 2–3: Default directory names**

| Directory name | Used for |
|---|---|
| hd0:/APP/TDSJITV2/TEMP | Setup files, data log files, and min/max waveform files |
| hd0:/WFMS | Waveform files used in the tutorial |

***WARNING.*** *To avoid corrupting the application, do not access the SYSTEM directory. Some files are only for internal use by the application.*

**File Name Extensions.** Table 2–4 lists file name extensions used or generated by the application.

**Table 2–4: File name extensions**

| Extension | Type |
|---|---|
| .csv | Log file that uses a “comma separated variable” format |
| .wfm | Waveform file that can be recalled into a reference memory |
| .ini | Application setup file |
| .set | Oscilloscope setup file created by the application |

## Configuring the Display

You can change how dialog boxes appear on your oscilloscope, as well as the color of waveforms. The next figure shows how to access the Display Options menu, and Table 2–5 lists the options with a brief description of each.

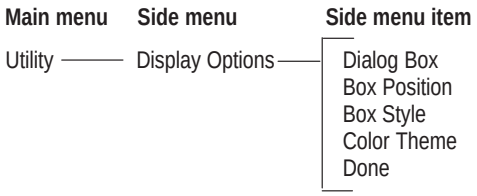



**Table 2–5: Display Options menu selections**

| Selection | Description |
|---|---|
| Dialog Box | Makes dialog boxes visible or invisible |
| Box Position | Positions the dialog box in the display to the left, middle, or right |
| Box Style | Selects the style of dialog boxes to be opaque or transparent |
| Color Theme | Selects a set of colors for waveforms and dialog boxes; the application offers seven color themes |

## Setting Up the Application

You can set up the application to take up to six measurements at the same time. In addition, you can plot the results in four formats, and save the statistical results or the worst case waveforms to a file to view later.

### Selecting Measurements

The next figure shows how to access the selections in the Select Measurement side menu, and Table 2–6 lists the measurements with a brief description of each.

***NOTE**. You can choose the* Clear All Selected *side menu item to remove all the measurements in the Select Active Measurements menu.*

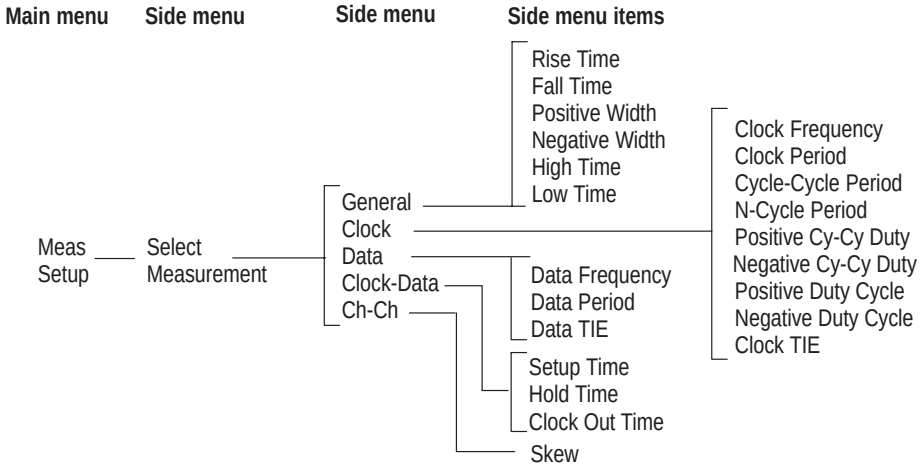



**Table 2–6: Select Measurement menu selections**

| Group | Selection | Description |
|---|---|---|
| General | Rise Time | Elapsed time from when a rising edge crosses the low reference voltage level and then the high reference voltage level |
| | Fall Time | Elapsed time from when a falling edge crosses the high reference voltage level and then the low reference voltage level |
| | Positive Width | Difference in time between the leading edge and trailing edge of a pulse |
| | Negative Width | Difference in time between the trailing edge and leading edge of a pulse |
| | High Time | Amount of time a waveform remains above the high reference voltage level |
| | Low Time | Amount of time a waveform remains below the low reference voltage level |
| Clock | Clock Period* | Elapsed time between when a waveform crosses a specific reference voltage level twice |
| | Clock Frequency* | Inverse of the period for each clock cycle |
| | Cycle-Cycle Period* | Difference in period measurements from one cycle to the next |
| | N-Cycle Period* | Difference in period measurements from cycles between two consecutive groups of N-cycles where N is any number |
| | Positive Cy-Cy Duty | Difference between two consecutive positive widths |
| | Negative Cy-Cy Duty | Difference between two consecutive negative widths |
| | Positive Duty Cycle* | Ratio of the positive portion of the cycle relative to the period |
| | Negative Duty Cycle* | Ratio of the negative portion of the cycle relative to the period |
| | Clock TIE* | Difference in time between the designated edge on a sampled clock waveform to the designated edge on a calculated clock waveform with a constant frequency (zero jitter) |
| Data | Data Period | Elapsed time between when a waveform crosses a specific reference voltage level in the same direction twice |
| | Data Frequency | Inverse of the period for each data cycle |

**Table 2–6: Select Measurement menu selections (Cont.)**

| Group | Selection | Description |
|---|---|---|
| | Data TIE | Difference in time between the data edges on a sampled data waveform to the data edges on a calculated data waveform with a constant rate (zero jitter) |
| Clock-Data | Setup Time* | Elapsed time between when a data waveform crosses a voltage reference level followed by the clock signal crossing its own voltage level |
| | Hold Time* | Elapsed time between when the clock waveform crosses a voltage reference level followed by a data waveform crossing its own voltage level |
| | Clock Out Time* | Elapsed time between when the clock waveform crosses a voltage reference level followed by an output waveform crossing its own voltage level |
| Ch-Ch | Skew* | Difference in time between the designated edge on a principal waveform to the designated edge on another waveform |

*** Requires configuration.**

## Selecting a Measurement to Configure

You may need to configure one or more of the selected measurements. The next figure shows how to select the measurement for configuration.

## Configuring a Measurement

Many measurements require configuration, as indicated in Table 2–7. The next figure shows how to access the Configure Selected menu for each measurement.


Table 2–7 lists the measurements and configuration selections with a brief description of each. Refer to the *Parameters* section for default values.

**Table 2–7: Measurements and configuration selections**

| Measurement | Selection | Description |
|---|---|---|
| Rise Time, Fall Time, Positive Width, Negative Width, High TIme, Low Time, Positive Cy-Cy Duty, Negative Cy-Cy Duty, Data Period, Data Frequency, Data TIE | None | No configuration is required for these measurements |
| Clock Frequency, Clock Period, Cycle-Cycle Period, Positive Duty Cycle, Negative Duty Cycle, and Clock TIE, N-Cycle Period, Setup Time, Hold Time, Clock Out Time | Common Cycle Start Edge | Defines which edge of the Main input is used to calculate all active clock-based measurements |

**Table 2–7: Measurements and configuration selections (Cont.)**

| Measurement | Selection | Description |
|---|---|---|
| N-Cycle Period | Cycle Span N= | Number of cycles between cycles actually measured |
| | Meas Made Every | Specifies if the measurement is taken on all 2N groups (option 1) or on every Nth 2N group (option N) |
| | Start Meas at Cycle # | Number of cycles skipped prior to starting the measurement |
| Setup Time, Hold Time, Clock Out Time | Common Data Cycle Edge | Edge on the data waveform used to take the measurement; you can define the waveform in the Inputs: 2nd menu |
| | Range Max* | Specify the maximum range of valid measurement values |
| | Range Min* | Specify the minimum range of valid measurement values |
| Skew | From Edge | Edge on the Main waveform used to take the measurement |
| | To Edge | Edge on the 2nd waveform used to take the measurement |
| | Range Max* | Specify the maximum range of valid measurement values |
| | Range Min* | Specify the minimum range of valid measurement values |

*** Although you can enter the same values for the Range Max and Range Min side menu items, the application requires that they always be at least one resolution apart. The application displays the actual value for Range Max or Range Min, whichever was last selected, in the upper right corner of the display.**

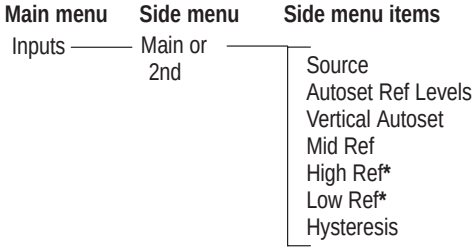
## Specifying Inputs

The application takes measurements from waveforms specified as inputs.

***NOTE**. All General, Clock, and Data measurements require a Main input.*

*All Clock-Data and Ch-Ch measurements require a Main input and a 2nd input.*

The next figure shows how to access parameters in the Main Input and 2nd Input menus.




***Only available for the Main Input.**

***NOTE**. The Input Summary shows the settings of all the Input menus.*

Table 2–8 lists the Main Input and 2nd Input menu selections with a brief description of each.

**Table 2–8: Main Input and 2nd Input menus selections**

| Selection | Description |
|---|---|
| Source | Sets which waveform the application uses as the signal or clock source |
| Autoset Ref Levels | Refer to Table 2–9 |
| Vertical Autoset | Changes the vertical scale and position for Ch 1, Ch 2, Ch 3, and Ch 4 waveforms so that they occupy the full vertical space available on the display without any part of the waveform missing (clipped) |
| Mid Ref | Sets the middle threshold level on the slope, in volts; refer to Figure 2–2 |
| High Ref* | Sets the high threshold level on the slope, in volts; refer to Figure 2–2 |
| Low Ref* | Sets the low threshold level on the slope, in volts; refer to Figure 2–2 |
| Hysteresis | Sets the threshold margin, in volts, relative to the reference level which the voltage must cross to be recognized as changing; the margin is the voltage reference level *plus or minus half* the hysteresis |

***Only available for the waveform defined in the Main Input menu.**

***NOTE.*** *The application detects the minimum and maximum voltage levels of the waveform. If the reference voltage level plus or minus the hysteresis falls outside of 2.5% to 97.5% of the waveform peak-to-peak range, no measurement is taken.*

Figure 2–2 shows how to determine the voltage reference levels.

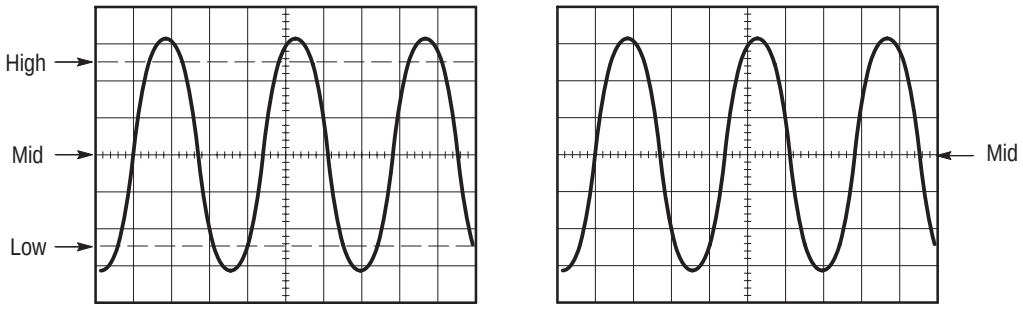
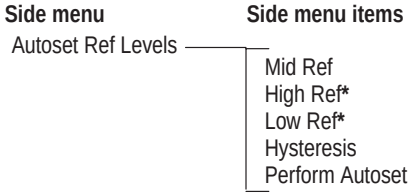



**Figure 2–2: How to determine voltage reference levels**

**Autoset Ref Levels Menu.** Autoset is only valid when Ch1, Ch2, Ch3, or Ch4 are selected as the Source for the Main Input, 2nd Input, or Qualifier Input menus. The next figure shows how to access parameters in the Autoset Ref Levels menus.




***Only available for the Main Input.**

Table 2–9 lists the Autoset Ref Levels menu selections with a brief description of each. The Autoset Ref Levels function is only valid for signals on Ch1, Ch2, Ch3, and Ch4.

**Table 2–9: Autoset Ref Levels menu selections**

| Selection | Description |
|---|---|
| Mid Ref | Sets the middle threshold level as a percentage of the voltage levels relative to the minimum and maximum levels of the peak-to-peak values |
| High Ref* | Sets the high threshold level as a percentage of the voltage levels relative to the minimum and maximum levels of the peak-to-peak values |
| Low Ref* | Sets the low threshold level as a percentage of the voltage levels relative to the minimum and maximum levels of the peak-to-peak values |
| Hysteresis | Sets the threshold margin as a percentage of the voltage levels relative to the reference level which the voltage must cross to be recognized as changing; the margin is the voltage reference level *plus or minus half* the hysteresis |
| Perform Autoset | Calculates and sets the threshold levels and margin |

***Only available for the waveform defined in the Main Input menu.**

***NOTE.*** *If you perform an Autoset on Ch1, Ch2, Ch3, or Ch4 and then change the Source to a reference memory or math waveform, the application will retain the previous Autoset reference level values. If the values are not appropriate, you must set the values for the voltage reference levels and hysteresis manually.*

**Deskew Menu.** The next figure shows how to access parameters in the Deskew menu and Table 2–10 lists the setup parameters with a brief description of each.

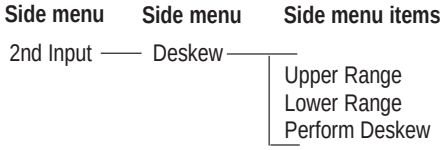



**Table 2–10: Deskew menu selections**

| Selection | Description |
|---|---|
| Upper Range | Specifies the upper range of valid measurement values |
| Lower Range | Specifies the lower range of valid measurement values |
| Perform Deskew | Starts the Deskew utility |

***NOTE.*** *To deskew the probes and oscilloscope channels, refer to* Deskewing the Probes and Channels *starting on page 1–4.*

## Specifying Qualifiers

Qualifiers allow you to focus the application on more narrowly defined conditions before taking measurements. This is one way to filter out information that is not useful to analyze.

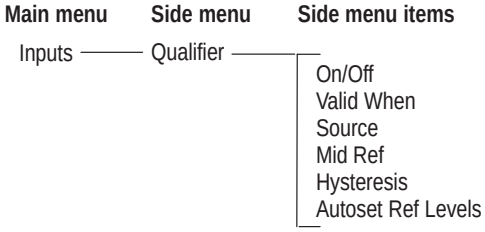



Table 2–11 lists the Qualifier Input menu selections with a brief description of each.

**Table 2–11: Qualifier Input menu selections**

| Selection | Description |
|---|---|
| On/Off | Enables the qualifier |
| Valid When | Specifies the state condition of the qualifier that must be met as either a logical low (0) or a logical high (1) |
| Source | Sets which waveform the application uses as the qualifier source |
| Mid Ref | Sets the middle threshold level on the slope, in volts; refer to Figure 2–2 |

**Table 2–11: Qualifier Input menu selections (Cont.)**

| Selection | Description |
|---|---|
| Hysteresis | Sets the threshold margin, in volts, relative to the reference level which the voltage must cross to be recognized as changing; the margin is the voltage reference level *plus or minus half* the hysteresis |
| Autoset Ref Levels | Refer to Table 2–9 |

***NOTE.*** *The Qualifier Input and Gating functions are mutually exclusive. If you enable both, the application displays an error message.*

## Specifying Gating

Gating allows you to focus the application on a specific area of the waveform bound by cursors before taking measurements. This is one way to filter out information that is not useful to analyze.

**Main menu** — **Side menu**

Inputs — Gating: On/Off

***NOTE.*** *Disabling the V Bars Cursors on the oscilloscope causes the application to disable Gating although the application display will show that gating is On.*

## Using Horizontal Check

You can use the Horizontal Check to check if the Sample Rate is appropriate for the selected measurements. A message displays that tells you if the Sample Rate is appropriate for the Main Input or 2nd Input menus. Accurate measurements require at least two samples per edge. The next figure shows how to access this function.

**Main menu** — **Side menu**

Inputs — Horizontal Check

## Using Acquisition Timeout

You can use the Acquisition Timeout to set an appropriate amount of time that the application will wait to acquire data before it stops and displays an error message. The next figure shows how to access this function.

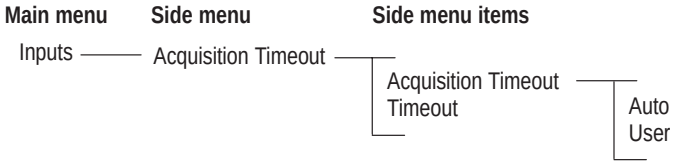



**Table 2–12: Acquisition Timeout menu selections**

| Selection | Description |
|---|---|
| Acq Timeout | Auto sets the timeout to less than 0.1 hours; User allows you to enter a larger timeout value |
| Timeout | When User is selected, you can set the timeout from 0.1 hour to 24 hours |

## Taking Measurements

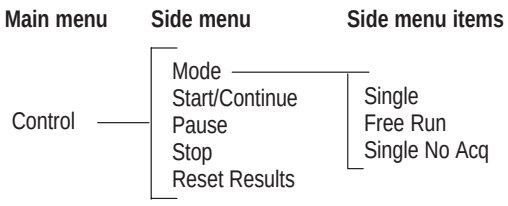
If you want to change trigger settings or localize the measurement, you should do so before you take any measurements.

***NOTE**. If you select a reference or math waveform as the source, you will need to recall and display the waveform before the application can take a measurement. For information on how to recall a waveform, refer to* Recalling a Waveform File *on page 2–29. To display the waveform, press the MORE button and the appropriate main menu item.*

*Be sure to press Control (main) → Reset Results (side) to reset the result values if you change the Vertical or Horizontal time settings between measurements.*

### Acquiring Data

You can start the application and oscilloscope to acquire data and take measurements through the Control menu. The next figure shows how to access parameters in the Control menu.




To take measurements from displayed waveforms, follow these steps:

**1.** Press Control (main). Table 2–13 lists selections in the Control menu.

**Table 2–13: Control menu selections**

| Selection | Description |
|---|---|
| Mode | |
| Single | Performs measurements on a single acquisition and stops |
| Free Run | Repeatedly acquires the input waveform(s) and takes measurements |
| Single No Acq | Performs measurements on a previous acquisition and then stops |
| Start | The application starts to take measurements from the waveform(s) |
| Continue | When paused, the application continues taking measurements |
| Pause | The application pauses and resumes when you press Continue or stops when you press Stop |
| Stop | The application stops taking measurements |
| Reset Results | Resets all result values to zero; data log files have their own reset selection |

***NOTE.*** *Acquisition Timeout causes the application to stop after a specific amount of time has elapsed when acquiring data and taking measurements. If you change any oscilloscope settings, be sure to reset the results.*

2. Press Mode (side) to select Single or Free Run acquisition mode.
3. Press Start (side).

***NOTE.*** *Do not change oscilloscope settings while a measurement is being taken, since this can cause an invalid measurement.*

## Localizing Measurements

You can control the amount of data to measure by adjusting the Record Length, or the Trigger Position. By specifying the Trigger Position, the starting point, and the total length of the measurement, you can effectively size the area of interest.

***NOTE.*** *If an error message displays because there are not enough cycles from which to take a measurement, you should increase the Record Length.*

*Be sure to reset the results each time you change the Record Length or other oscilloscope settings.*

## Warning Messages

The application displays and saves warning messages if the input conditions do not support accurate measurements. You can view the most recent message, if any, for the current acquisition in the Results menu or the Plots menu. The next figure shows how to access warning messages.

| Main menu | Side menu |
|---|---|
| Results | Warning |
| Plots | Warning |

## Analyzing the Results

The application provides information on the variation of timing measurements as statistical values in a readout, or graphically as a Histogram, Time Trend, Cycle Trend, or Spectrum plot.

***NOTE.*** *Stop the acquisition before viewing the results as plots if you are taking measurements in the Free Run mode.*

Figure 2–3 shows an example of the various results display formats.

Results Summary

Results Summary

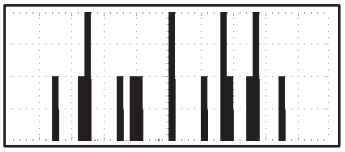
| Meas | Mean | Population |
|---|---|---|
| 1 CP | 12.502ns | 19 |
| 2 CF | 79.987MHz | 19 |
| 3 CCP | 6.5586ps | 18 |
| 4 | | |
| 5 | | |
| 6 | | |

Results Detail

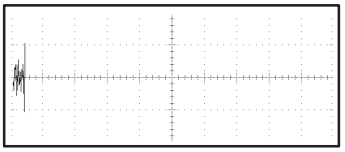
Result Details

| Clock Period | | Clock Freq | | Cy.Cy.Period | |
|---|---|---|---|---|---|
| Mean | 12.502ns | Mean | 79.987MHz | + Mean | 70.370ps |
| Max | 12.604ns | Max | 80.672MHz | + Max | 208.33ps |
| Min | 12.396ns | Min | 79.339MHz | + Pop | 9 |
| Pk–Pk | 208.33ps | Pk–Pk | 1.3334MHz | – Mean | –57.253ps |
| SD | 47.816ps | SD | 306.07kHz | – Max | –104.17ps |
| Pop | 19 | Pop | 19 | – Pop | 9 |
| | | | | SD | 81.325ps |
| | | | | Pop | 18 |

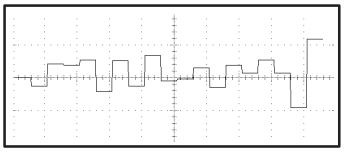
Histogram plot



Cycle Trend plot



Time Trend plot



Spectrum plot

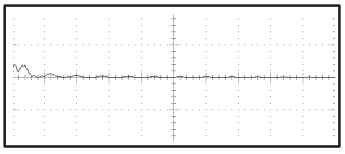
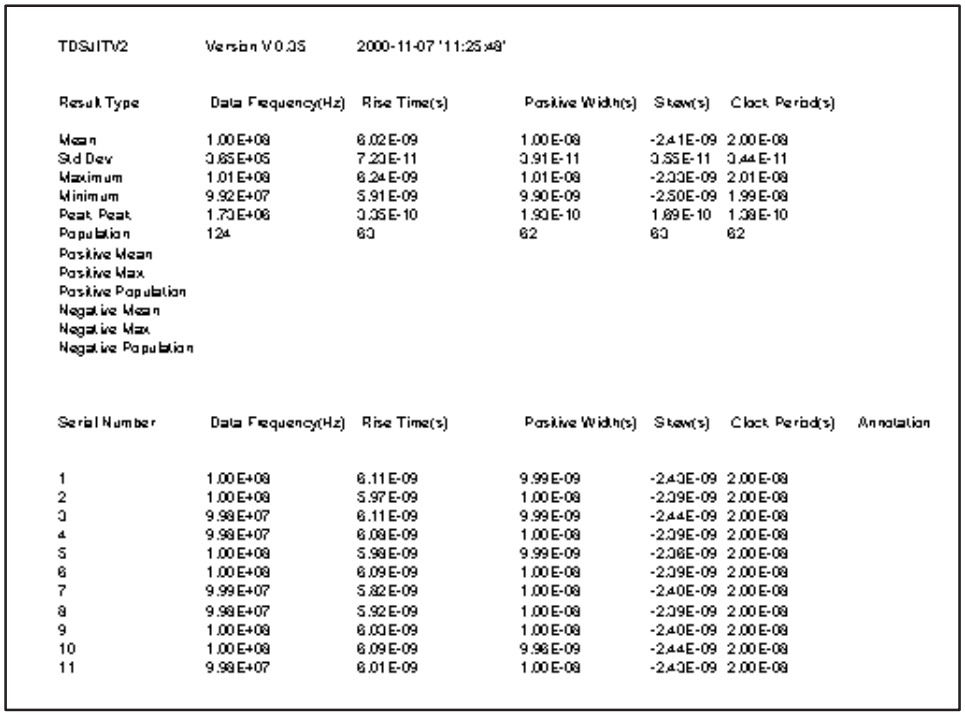


**Figure 2–3: Example of the results and display formats**

You can also log the data to a RESULTS.CSV file for viewing with a text editing, spreadsheet, database, or data analysis program on a personal computer. Figure 2–4 shows an example of how the RESULTS.CSV file might look in a spreadsheet.



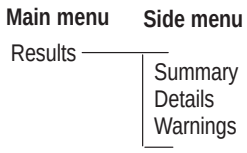
| TDSJITV2 | Version V 0.05 | 2000-11-07 '11:25:49' | | | |
|---|---|---|---|---|---|
| Result Type | Data Frequency(Hz) | Rise Time(s) | Positive Width(s) | Skew(s) | Clock Period(s) |
| Mean | 1.00E+08 | 6.02E-09 | 1.00E-08 | -2.41E-09 | 2.00E-08 |
| Std Dev | 0.65E+05 | 7.23E-11 | 0.91E-11 | 0.55E-11 | 0.44E-11 |
| Maximum | 1.01E+08 | 6.24E-09 | 1.01E-08 | -2.33E-09 | 2.01E-08 |
| Minimum | 9.92E+07 | 5.91E-09 | 9.90E-09 | -2.50E-09 | 1.99E-08 |
| Peak Peak | 1.73E+06 | 3.35E-10 | 1.93E-10 | 1.69E-10 | 1.38E-10 |
| Population | 124 | 60 | 62 | 60 | 62 |
| Positive Mean | | | | | |
| Positive Max | | | | | |
| Positive Population | | | | | |
| Negative Mean | | | | | |
| Negative Max | | | | | |
| Negative Population | | | | | |

| Serial Number | Data Frequency(Hz) | Rise Time(s) | Positive Width(s) | Skew(s) | Clock Period(s) | Annotation |
|---|---|---|---|---|---|---|
| 1 | 1.00E+08 | 6.11E-09 | 9.99E-09 | -2.43E-09 | 2.00E-08 | |
| 2 | 1.00E+08 | 5.97E-09 | 1.00E-08 | -2.39E-09 | 2.00E-08 | |
| 3 | 9.98E+07 | 6.11E-09 | 9.99E-09 | -2.44E-09 | 2.00E-08 | |
| 4 | 9.98E+07 | 6.08E-09 | 1.00E-08 | -2.39E-09 | 2.00E-08 | |
| 5 | 1.00E+08 | 5.98E-09 | 9.99E-09 | -2.36E-09 | 2.00E-08 | |
| 6 | 1.00E+08 | 6.09E-09 | 1.00E-08 | -2.39E-09 | 2.00E-08 | |
| 7 | 9.99E+07 | 5.82E-09 | 1.00E-08 | -2.40E-09 | 2.00E-08 | |
| 8 | 9.98E+07 | 5.92E-09 | 1.00E-08 | -2.39E-09 | 2.00E-08 | |
| 9 | 1.00E+08 | 6.03E-09 | 1.00E-08 | -2.40E-09 | 2.00E-08 | |
| 10 | 1.00E+08 | 6.09E-09 | 9.98E-09 | -2.44E-09 | 2.00E-08 | |
| 11 | 9.98E+07 | 6.01E-09 | 1.00E-08 | -2.43E-09 | 2.00E-08 | |

**Figure 2–4: A RESULTS.CSV file viewed in a spreadsheet program**

## Viewing Statistics

The application can display results for up to six measurements. The next figure shows how to access the Summary, Details, and Warnings message boxes.




The statistical information that displays will vary by measurement. In general, the Summary and Details message boxes contain statistical values for the mean, the standard deviation (StdDev), the peak-to-peak (Pk-Pk), the maximum (Max) and minimum (Min) values, and the population (the number of samples used to calculate the statistics).

Figure 2–5 shows an example of the results for three measurements.

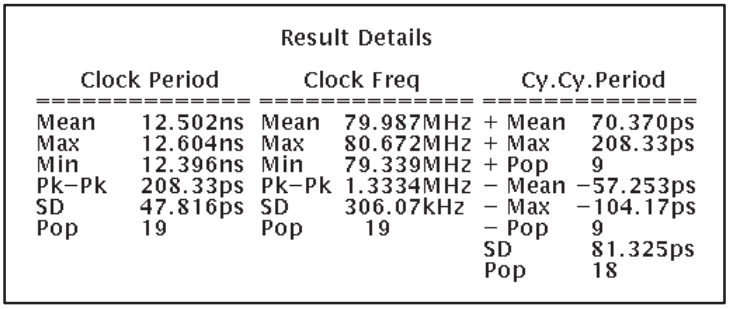
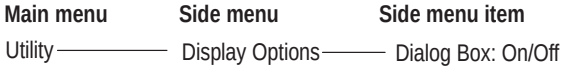



**Figure 2–5: Results Details menu, example of three measurements**

To view parts of the waveform that are obscured by the statistics, press the CLEAR MENU button. To return to the application, press the SHIFT, and then the APPLICATION front-panel menu buttons

***NOTE**. To view the waveform and the results, you can adjust the placement of the statistics in the display or make dialog boxes translucent through the Display Options side menu.*

The next figure shows how to make the statistics and all dialog boxes visible or invisible.




## Viewing Plots

You can graphically plot the results for easier analysis. There are four plot formats: Histogram, Time Trend, Cycle Trend, and Spectrum. The next figure shows how to access the Plots menus.

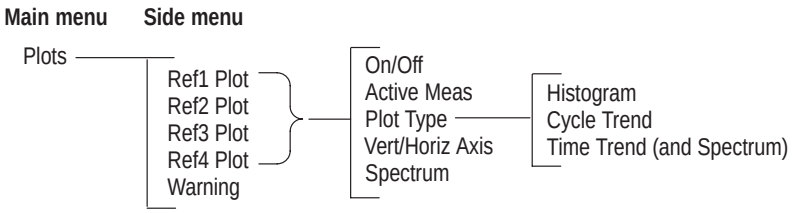



Table 2–14 lists the plot formats with a brief description of each.

**Table 2–14: Plot Type selections**

| Selection | Description |
|---|---|
| Histogram | Plots the results such that the horizontal axis represents the measurement values and the vertical axis represents the number of times that the value occurred |
| Cycle Trend | Plots the results such that the vertical axis represents the measurement value and the horizontal axis represents the index number of the measurement which can be used to observe the variation of a measurement |
| Time Trend* | Plots the results such that the vertical axis represents the measurement value and the horizontal axis represents the time the measurement occurred; the horizontal time span is the same as the input waveform |
| Spectrum** | Plots the spectral content (FFT) of the Time Trend plot where the vertical axis represents magnitude and the horizontal axis represents frequency |

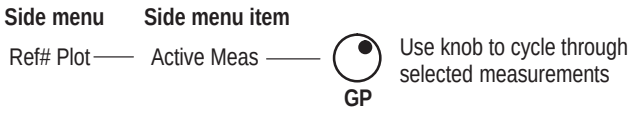
*** Limited to a 50,000 point record length; if the plot exceeds this limit, use Decimation.**

**** Limited to a 10,000 point record length; if the plot exceeds this limit, use Decimation.**

***NOTE**. You must take a measurement before displaying the results as a plot. The application will automatically display a plot when it is enabled.*

*Be sure to reset the results each time you change oscilloscope settings.*

The next figure shows how to select an active measurement to display as a plot.




**Vert/Horiz Axis for a Histogram Plot.** The next figure shows how to access the Vert/Horiz Axis parameters for a Histogram plot.

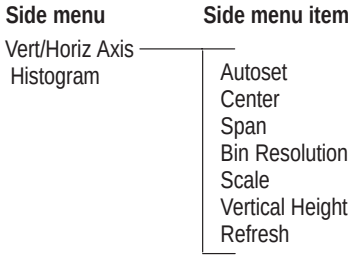



Table 2–15 lists the Vert/Horiz Axis parameters for a Histogram plot with a brief description of each.

**Table 2–15: Vert/Horiz Axis Histogram menu selections**

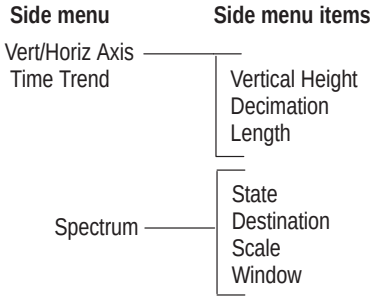
| Selection | Description |
|---|---|
| Autoset* | Uses the results to determine logical values for the Center and Span parameters if the population of the measurement is 3 or more, and redraws the plot in the corresponding reference memory<br><br>After using Autoset, the oscilloscope cursors are not available |
| Center | Numeric value for the horizontal center position of the histogram |
| Span | Numeric value for the total horizontal range of the histogram |
| Bin resolution | Selects the resolution as defined by bins to be Low (20 bins), Medium (100 bins), or High (500 bins) |
| Scale | Vertical axis is in logarithmic or in linear scale |
| Vertical Height | Height of the plot in number of divisions |
| Refresh | Updates the plot with the latest Center and Span values entered |

***You must select On for the Ref# Plot that will store the Histogram and take a measurement before using Autoset.**

***NOTE**. Use the HORIZONTAL SCALE knob to adjust the horizontal scale of the waveform to fit the screen for proper viewing.*

*Use the Autoset function to set the optimum Center and Span values. You can use Autoset only after taking measurements and storing them as a Histogram plot.*

**Vert/Horiz Axis for a Time Trend and Spectrum Plots.** The next figure shows how to access the Vert/Horiz Axis parameters for a Time Trend plot, and how to access the Spectrum plot.



***NOTE**. The Time Trend plot is limited to a 50,000 point record length; the Spectrum plot is limited to a 10,000 point record length. If the record length exceeds these limits, use Decimation to plot the results with fewer samples.*

Table 2–16 lists the Vert/Horiz Axis parameters for a Time Trend plot with a brief description of each.

**Table 2–16: Vert/Horiz Axis Time Trend menu selection**

| Selection | Description |
|---|---|
| Vertical Height | Height of the plot in number of divisions |
| Decimation | Produces a waveform with fewer samples than in the original acquisition |
| Length | For decimation, the length of the plot in number of record points |

To view the results in a Time Trend plot, follow these steps:

1. Take jitter measurements.
2. If the record length is greater than 50,000 points, enable Decimation and select an appropriate value for the Length side menu item.
3. Enable the Time Trend plot; the application automatically displays the plot.

Table 2–17 lists the parameters for a Spectrum plot with a brief description of each.

**Table 2–17: Spectrum menu selection**

| | |
|---|---|
| State | Enables the application to plot the results as a spectrum |
| Destination | Sets the Math1, Math2, or Math3 waveform in which to store the plot |
| Scale | Vertical axis is in logarithmic or in linear scale |
| Window | Reduces spectral leakage in the Fast Fourier Transform (FFT) waveform; a Hanning window (raised cosine) on the Time Trend data |

To view the results in a Spectrum plot, follow these steps:

1. Take jitter measurements.
2. If the record length is equal to or less than 10,000 points, go to step 3.

   If the record length is greater than 10,000 points, enable Decimation and select an appropriate value for the Length side menu item that is equal to or less than 10,000 points.

3. Enable the Time Trend plot; the application automatically displays the plot.
4. Enable the Spectrum plot; the application automatically displays the plot in the MORE menu of the oscilloscope.
5. To return to the application, press the SHIFT, and then the APPLICATION front-panel menu buttons.

**Vert/Horiz Axis for a Cycle Trend Plot.** The next figure shows how to access the Vert/Horiz Axis parameters for a Cycle Trend plot.

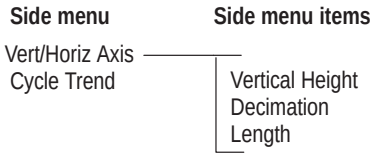



Table 2–18 lists the Vert/Horiz Axis parameters for a Cycle Trend plot with a brief description of each.

**Table 2–18: Vert/Horiz Axis Cycle Trend menu selections**

| Selection | Description |
|---|---|
| Vertical Height | Height of the plot in number of divisions |
| Decimation | Produces a waveform with fewer samples than in the original acquisition |
| Length | For decimation, the length of the plot in number of record points |

### Clearing Results

To reset the results to zero, press Control (main) → Reset Results (side). You do not have to wait for a measurement to complete to clear the results.

## Saving the Results to a File

You can save the results for all active measurements as statistics to a data log file or save the minimum and maximum worst case waveforms to waveform files. You can also change the active measurements and continue to log data to the same data log file.

### Logging Statistics

This type of logging saves the statistical results and the individual result points of activated measurements to a data log file. The next figure shows how to access the Log Results menu.

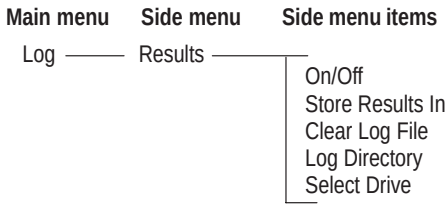



Table 2–19 lists the Log Results menu selections with a brief description of each.

**Table 2–19: Log Results menu selections**

| Selection | Description |
|---|---|
| On/Off | Enables or disables the data log file; when enabled, stores the measurement results in a "comma separated variable" formatted file (.CSV file) that you can view on a personal computer |
| Store Results In | Allows you to enter a name for the .CSV file |
| Clear Log File | Clears the data log file; you must disable the log file before you can clear its contents |
| Log Directory | Selects the directory in which the .CSV file will be saved; when you select this side menu item, the directory structure of the selected drive displays. |
| Select Drive | Selects the drive on which the .CSV file will be stored |

***NOTE.*** *If the disk is full or not present, the application displays an error message and stops taking measurements.*

*A data log file larger than 1.4 MB exceeds the capacity of a floppy disk. Refer to* Appendix D: Example Program to Copy Large Files *for an example of a GPIB program that you can use to transfer a large data log file from the oscilloscope to a personal computer.*

## Data Log File Format

The data log file contains three parts: a header row, statistical results, and individual result points. The header row of the log file contains the application name, the version number of the application, and the date and time on which the file was created.

For statistical results, the application updates the rows for all of the active measurements. For individual result points, the application appends rows of results to each active measurement.

***NOTE**. If you are using a GPIB program to execute the application, such as in automated test environments, you can add your own annotation through the logAnnotate GPIB command. You can add information consisting of up to 20 characters; the custom information will appear as the last column in the individual result records of that acquisition.*

## Logging Min/Max Waveforms

This type of logging saves the acquired waveforms where the minimum and maximum worst cases occur. When enabled, the waveforms are saved to a set of .wfm files that are stored with the other application files.

The next figure shows how to access the Log Min/Max Wfms menu.

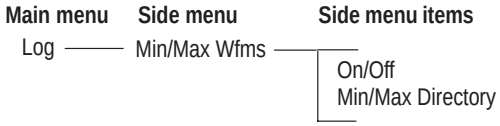



Table 2–20 lists the Log Min/Max Wfms menu selections with a brief description of each.

**Table 2–20: Log Min/Max Wfms menu selections**

| Selection | Description |
|---|---|
| On/Off | Enables the saving of worst case waveforms; see Table 2–21 for definition |
| Min/Max Directory | Changes the directory in which .wfm files will be stored |

***NOTE**. File names for the waveforms are unique to each measurement. The Min1 and Max1 waveform files are for the Main input. The Min2 and Max2 waveform files are for the 2nd input.*

Table 2–21 lists the file names of the minimum and maximum worst case waveforms for various measurements.

**Table 2–21: File names for Min/Max waveforms**

| Measurement | Min waveform | Max waveform |
|---|---|---|
| Rise Time | RISEMin1.wfm | RISEMax1.wfm |
| Fall Time | FALLMin1.wfm | FALLMax1.wfm |
| Positive Width | PWMin1.wfm | PWMax1.wfm |

**Table 2–21: File names for Min/Max waveforms (Cont.)**

| Measurement | Min waveform | Max waveform |
|---|---|---|
| Negative Width | NWMin1.wfm | NWMax1.wfm |
| High Time | HIGHMin1.wfm | HIGHMax1.wfm |
| Low Time | LOWMin1.wfm | LOWMax1.wfm |
| Clock Frequency | CFMin1.wfm | CFMax1.wfm |
| Clock Period | CPMin1.wfm | CPMax1.wfm |
| Cycle-Cycle Period | CCPMin1.wfm | CCPMax1.wfm |
| N-Cycle Period | NCPMin1.wfm | NCPMax1.wfm |
| Positive Cy-Cy Duty | PCCDMin1.wfm | PCCDMax1.wfm |
| Negative Cy-Cy Duty | NCCDMin1.wfm | NCCDMax1.wfm |
| Positive Duty Cycle | PDCMin1.wfm | PDCMax1.wfm |
| Negative Duty Cycle | NDCMin1.wfm | NDCMax1.wfm |
| Clock TIE | TIEMin1.wfm | TIEMax1.wfm |
| Data Frequency | DFMin1.wfm | DFMax1.wfm |
| Data Period | DPMin1.wfm | DPMax1.wfm |
| Data TIE | DTIEMin1.wfm | DTIEMax1.wfm |
| Setup Time | SUMin1.wfm<br>SUMin2.wfm | SUMax1.wfm<br>SUMax2.wfm |
| Hold Time | HOLDMin1.wfm<br>HOLDMin2.wfm | HOLDMax1.wfm<br>HOLDMax2.wfm |
| Clock Out Time | TCOMin1.wfm<br>TCOMin2.wfm | TCOMax1.wfm<br>TCOMax2.wfm |
| Skew Time | SKEWMin1.wfm<br>SKEWMin2.wfm | SKEWMax1.wfm<br>SKEWMax2.wfm |

## Importing a Data Log File to a Personal Computer

You can import the .CSV data log file (comma separated variable format) into a text editing, spreadsheet, database, or data analysis program on your personal computer for further analysis.

If you saved the data log file on the hard disk drive, you need to copy it to a floppy disk. To do so, follow these steps:

1. Insert a blank, DOS-formatted floppy disk into the floppy disk drive of the oscilloscope.

2. Copy the .CSV file from the hard disk drive to the floppy disk. For details on how to do this, refer to step 5 on page 2–41 in the *Tutorial* section.

To import a data log file to a personal computer, follow these steps:

1. Insert the floppy disk into the floppy disk drive on your personal computer.
2. Copy the .CSV file.
3. Open the file using a text editing, spreadsheet, database, or data analysis program.

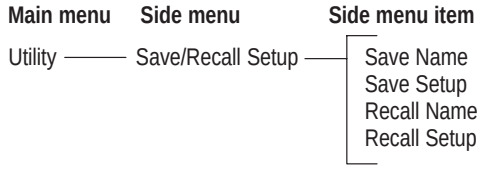
Figure 2–4 shows an example of the .CSV file viewed in a spreadsheet program.

If you take different measurements and store them in one data log file, you can group the measurements by sorting them in a program on a personal computer.

## Saving and Recalling Setups

You can use the Save/Recall Setup menu to save and recall application setups. The Save/Recall function also saves the oscilloscope set up.

The next figure shows how to access the Save/Recall Setup menu.




### Saving a Setup

To save the application setup to the file displayed in the Save Name menu item, press Save Setup (side).

To create a new file in which to save the application setup, follow these steps:

1. Press Save Name (side).
2. Use the direction arrows and Delete Char (side) to clear the existing file name or part of the file name.
3. Use the General Purpose (GP) knob to select each character in the file name. Press Enter Char (side) after selecting each character.

   The file name can be up to eight characters long excluding the extension. The application automatically appends a .ini and .set extension to the name.
4. Press OK Accept (side) to save the file name.
5. Press Save Setup (side) to store the application setup in the file just created.

6. Press OK (side).
7. Done (side).

Application setups are usually saved in the APPS/TDSJIT1V2/TEMP directory (accessed through the File Utilities menu) on the oscilloscope. Once you have saved a setup, you must recall it to use it again.

### Recalling a Setup

To recall the application settings from the Default setup file or from a saved setup file, follow these steps:

1. Press Recall Name (side); use the GP knob to select the directory where the setup file resides.

***NOTE.*** *The application starts with all parameters set to default values regardless of which setup file was last used.*

2. When you have found the setup file to recall, press Recall Setup (side).
3. Press OK (side).
4. Press Done (side).

## Exiting the Application

To exit the application, press Utility (main) → Exit (side). To confirm, press OK (side).

# Tutorial

This tutorial teaches you how to set up the application, take two types of measurements, and view the results in the various formats. Further operating information is located in the *Operating Basics* section.

Before you begin the tutorial, you must do the following tasks:

- Set up the oscilloscope
- Start the application
- Recalling waveforms to reference memories

## Setting Up the Oscilloscope

To set up the oscilloscope, follow these steps:

1. Press SETUP → Recall Factory Setup (main) → OK Confirm Factory Init (side) to set the oscilloscope to the default factory settings.
2. Press the WAVEFORM OFF button as often as necessary to remove active waveforms from the display.
3. Press HORIZONTAL MENU → –more– 1 of 3 (side) → 5000 points in 100 divs (side) to set the Record Length to 5000.

## Starting the Application

To perform these lessons, the TDSJIT1V2 application must be installed on the oscilloscope. See *Installation* on page 1–3.

To start the application, refer to Figure 2–6, and follow these steps:

1. Press SETUP → Select Application (main).
2. Use the general purpose (GP) knob to select hd0: and press SELECT.
3. Use the GP knob to select the TDSJIT1V2.APP file and press Activate Application (side).

The application starts up and displays as shown in Figure 2–7.

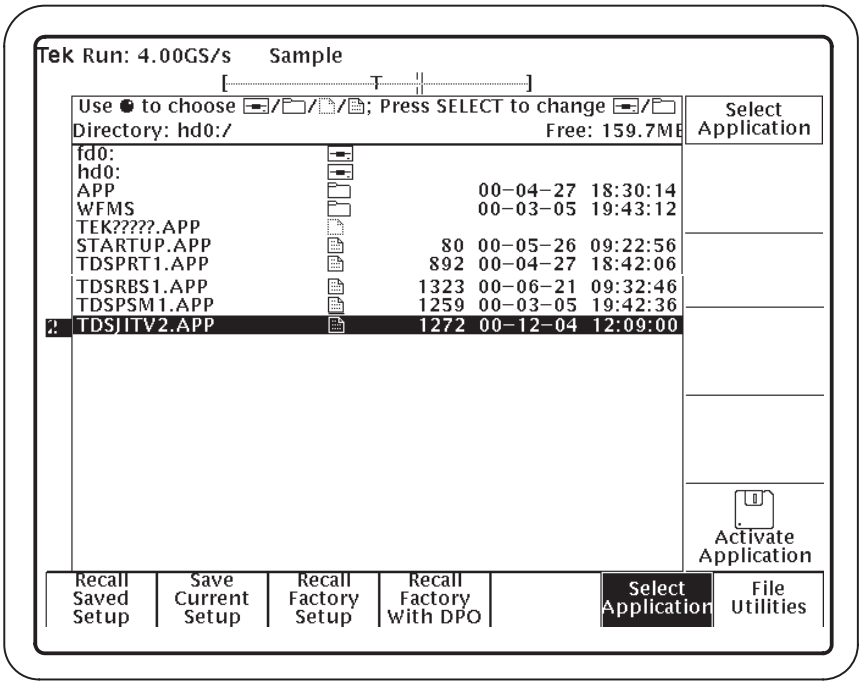



**Figure 2–6: Starting the application**

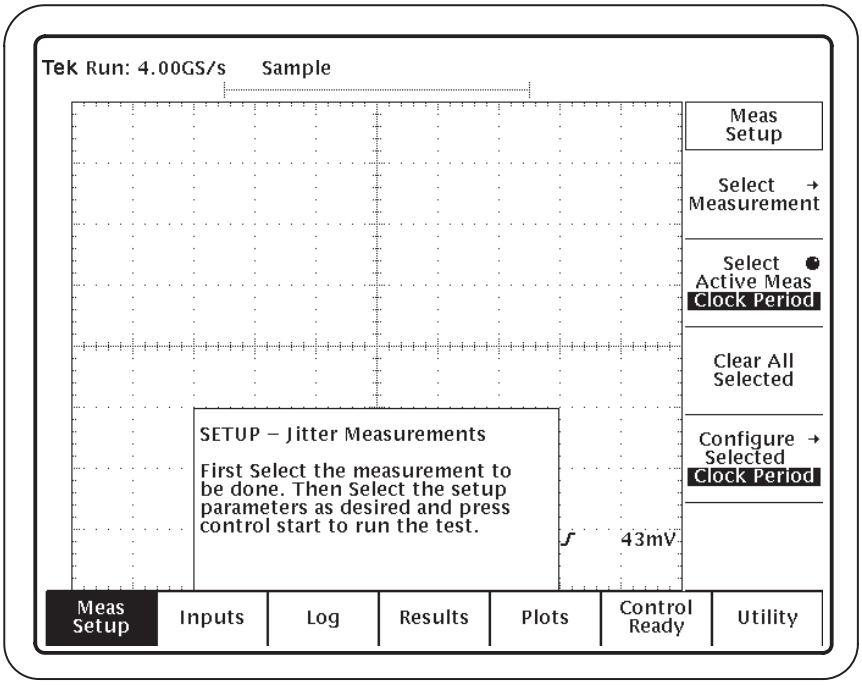



**Figure 2–7: TDSJIT1V2 application initial display**

## Recalling a Waveform File

The application includes waveform files for use with this tutorial. Table 2–22 shows the types of signals that these waveforms represent and the reference memory that you will recall them to.

**Table 2–22: Tutorial waveforms and signal types**

| Waveform name | Signal type | Recall to reference |
|---|---|---|
| J1V2_CLK.WFM | A clock signal | Ref4 |
| J1V2_DAT.WFM | A data signal | Ref3 |

To recall the clock waveform to Ref1, follow these steps:

1. Press WAVEFORM → Recall Wfm to Ref (main) → Recall from file (side).
2. Use the general purpose (GP) knob to select hd0: and press SELECT.
3. Use the GP knob to select WFMS and press SELECT.
4. Use the GP knob to select J1V2_CLK.WFM; press To Ref4 active/empty (side). Figure 2–8 shows how to recall a waveform.

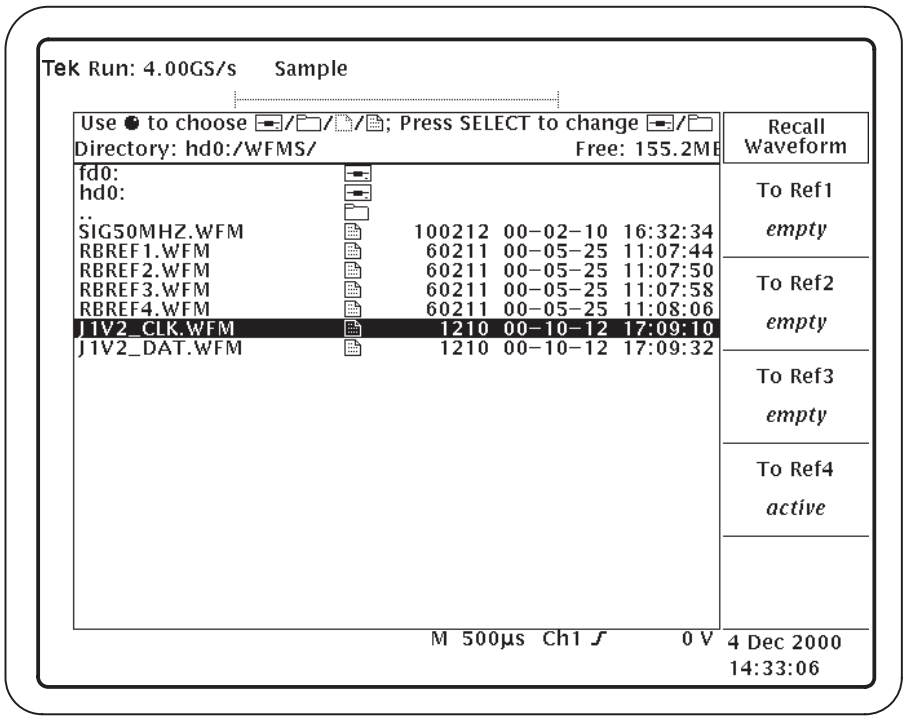



**Figure 2–8: Recalling a waveform to a reference memory**

5. Press the MORE front-panel button, and then Ref4 (main) to display the waveform. Figure 2–9 shows the J1V2_CLK.WFM recalled to Ref4.

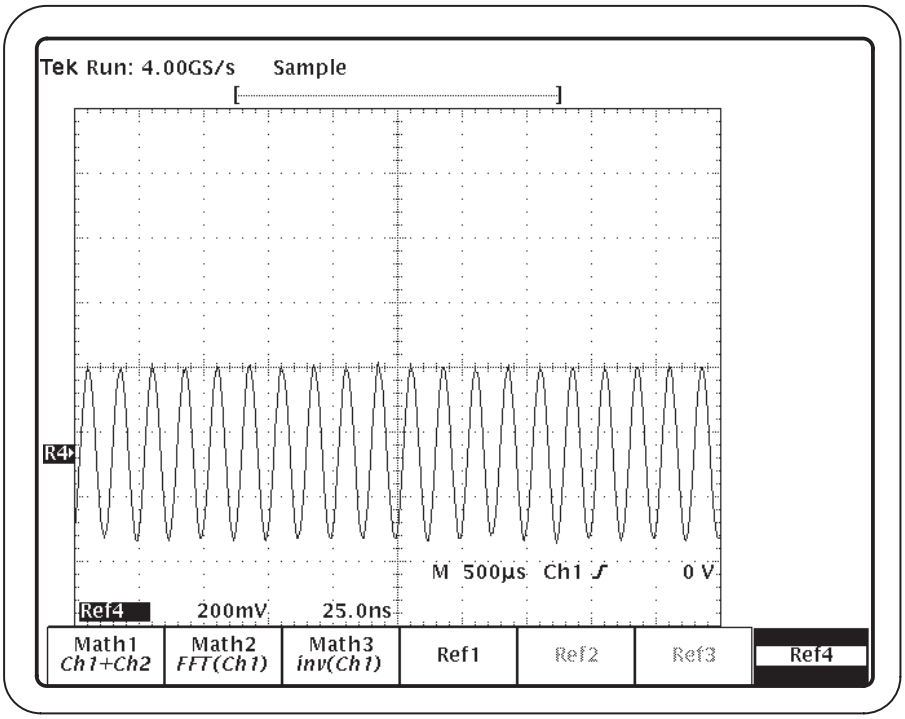



**Figure 2–9: J1V2_CLK.WFM recalled to Ref1**

6. Press the SHIFT, and then the APPLICATION front-panel menu button to return to the application.

## Taking a Clock Period Measurement

In this example, you will learn how to use the application to take a Clock Period measurement, how to view the results as statistics, and how to view the results in the various plot formats.

To take a Clock Period measurement, follow these steps:

1. Select Inputs (main) → Main (side) → Source (side) → –more– 1 of 4 (side) → –more– 2 of 4 (side) → Ref4 (side). Figure 2–10 shows the Main Input menu setup.

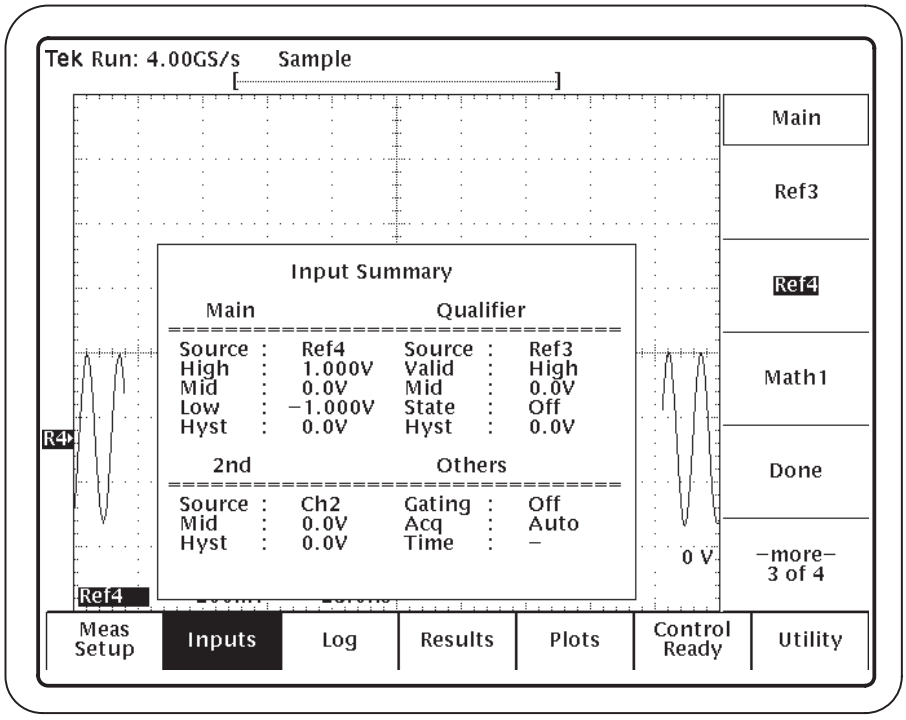



**Figure 2–10: Main Input menu setup**

**2.** Press Done (side) twice.

**3.** To take the measurement, press Control (main) → Start (side).

***NOTE.*** *When the input is a reference waveform, the measurement performs a single measurement cycle regardless of the acquisition mode.*

The Control menu (main) displays Control Sequencing while the application is executing. When the Control menu displays Control Ready, the application has completed the calculations.

**4.** Wait for the calculations to complete. Figure 2–11 shows the results.

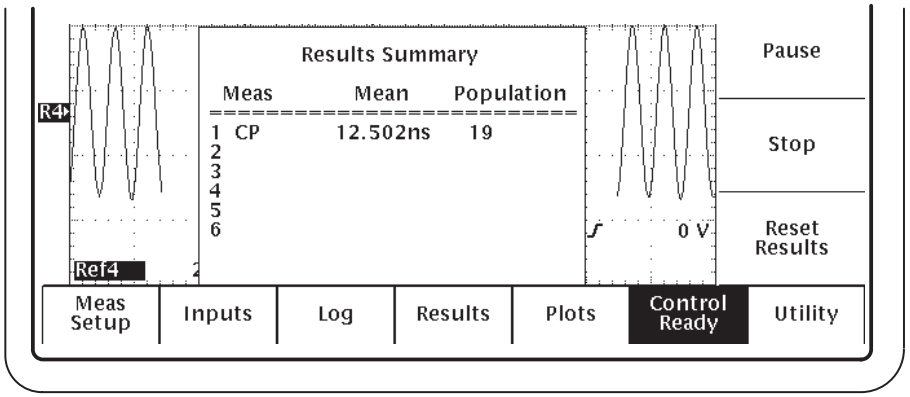



**Figure 2–11: Clock Period lesson: Results Summary readout**

5. To set up the Histogram plot format, select Plots (main) → Ref1 Plot (side) and select On.

   Figure 2–12 shows the setup for the Histogram plot.

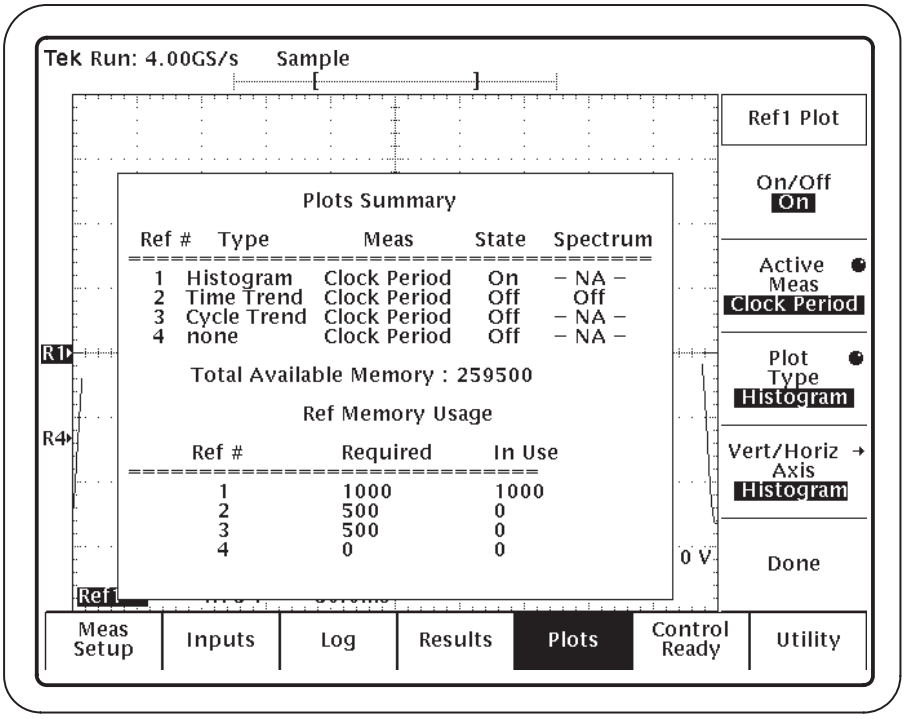



**Figure 2–12: Setup for a Histogram plot**

6. Press Vert/Horiz Axis Histogram(side) → Autoset (side) → Done (side).
7. Press the CLEAR MENU front-panel button.

   Figure 2–13 shows the Histogram plot.

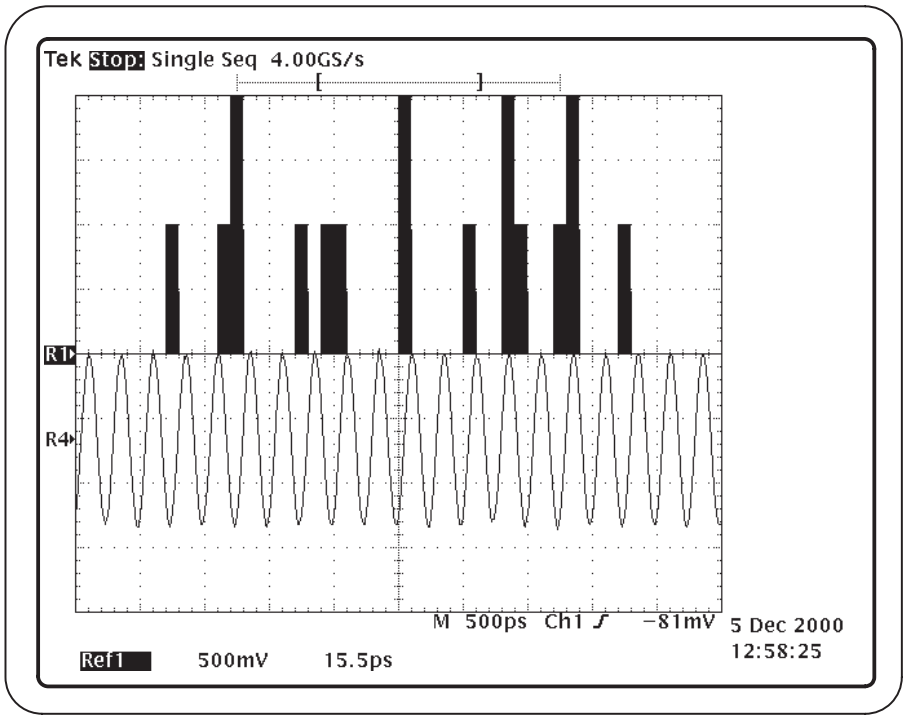



**Figure 2–13: Results as a Histogram plot**

8. Press the SHIFT, and then the APPLICATION front-panel menu button to return to the application.
9. To deselect the Histogram plot, press Off (side) → Done (side).
10. To set up the Time Trend plot format, select Ref2 Plot (side) → On (side).
11. Press the CLEAR MENU front-panel button.

    Figure 2–14 shows the Time Trend plot.

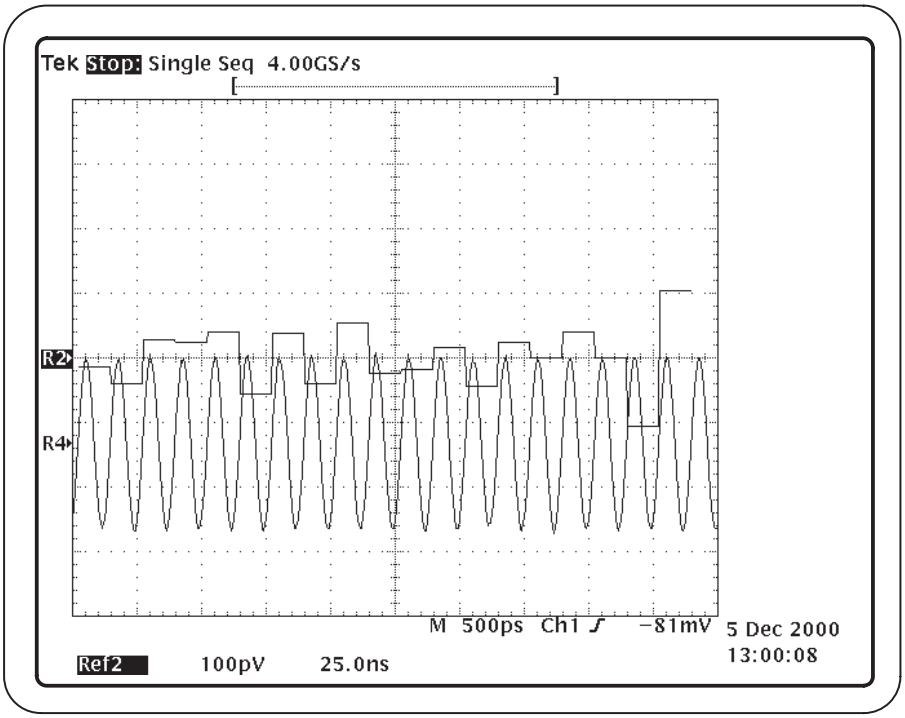



**Figure 2–14: Results as a Time Trend plot**

**12.** Press the SHIFT, and then the APPLICATION front-panel menu button to return to the application.

**13.** To set up the Spectrum plot format, select –more– 1 of 2 (side) → Spectrum (side). Figure 2–15 shows the setup for a Spectrum plot.

**14.** Select State (side) → On (side). As soon as you select On, the Spectrum plot displays as Math1 in the MORE menu of the oscilloscope.

Figure 2–16 shows the Spectrum plot.

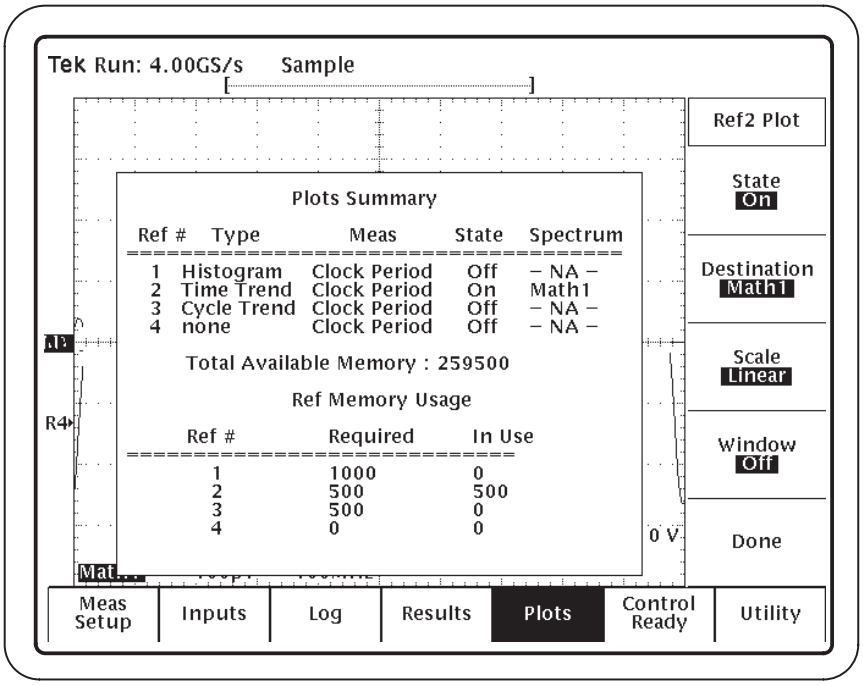



**Figure 2–15: Setup for a Spectrum plot**

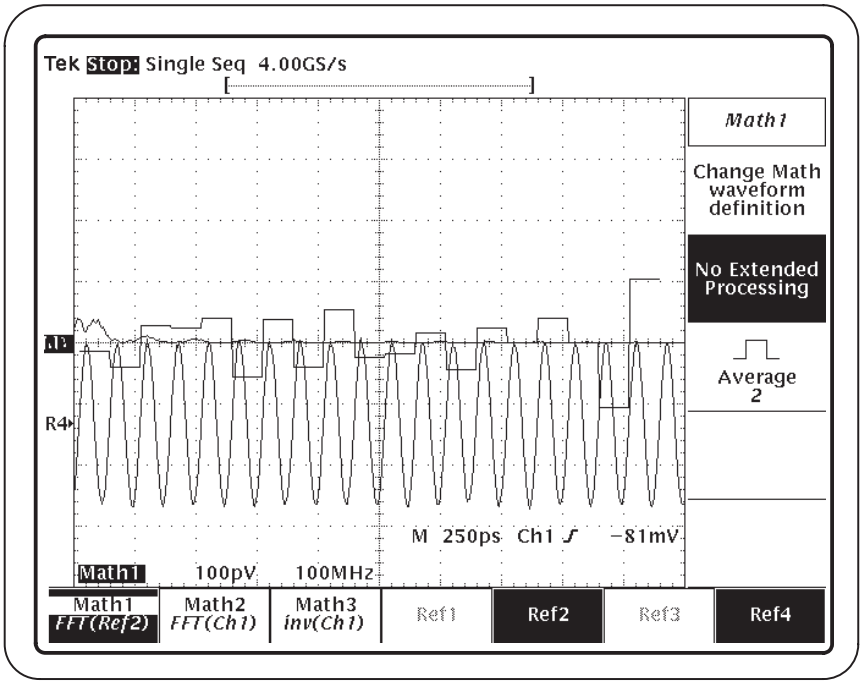



**Figure 2–16: Results as a Spectrum plot**

15. Press the SHIFT, and then the APPLICATION front-panel menu button to return to the application.

16. To deselect the Time Trend plot, press Done (side) → –more– 2 of 2 (side) → Off (side) → Done (side). This also deselects the Spectrum plot.

17. To set up the Cycle Trend plot format, select Ref3 Plot (side) → On (side).

18. Press the CLEAR MENU front-panel button.

    Figure 2–14 shows the Cycle Trend plot.

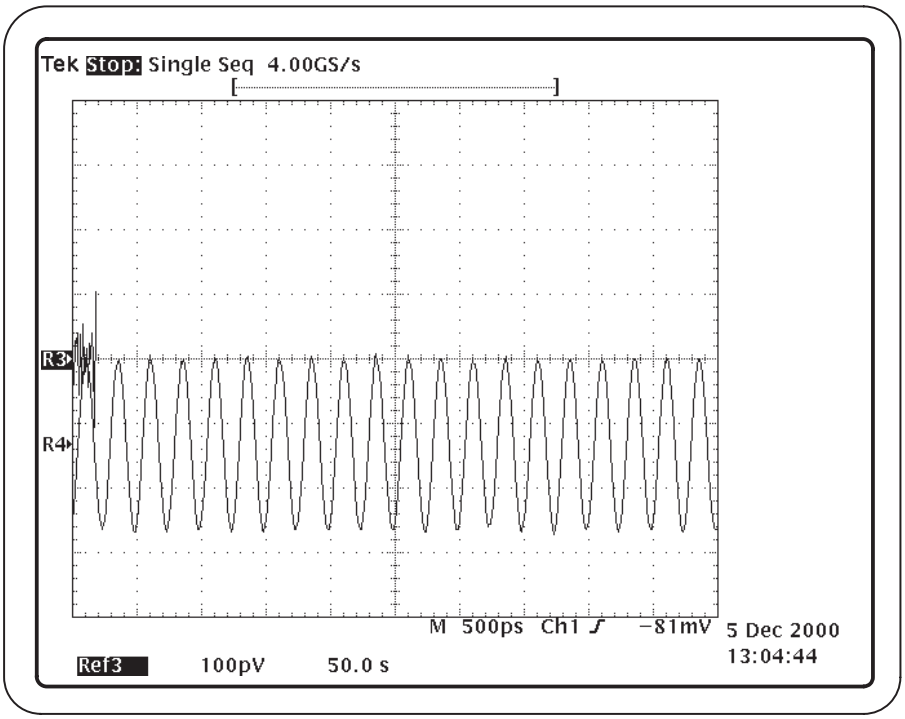



**Figure 2–17: Results as a Cycle Trend plot**

19. Press the SHIFT, and then the APPLICATION front-panel menu button to return to the application.

20. To deselect the Cycle Trend plot, press Off (side) → Done (side).

## Taking a Clock Out Time Measurement

In this example, you will learn how to use the application to take Clock Out Time (clock to output) and Clock Period measurements. To take a Clock Out Time measurement, you need two waveforms.

Retain the Main Input setup for Ref1 from the previous lesson. That waveform will be used in both measurements.

To recall the data waveform to Ref3, follow these steps:

1. Press WAVEFORM → Recall Wfm to Ref (main) → Recall from file (side).
2. Use the general purpose (GP) knob to select hd0: and press SELECT.
3. Use the GP knob to select WFMS and press SELECT.
4. Use the GP knob to select J1V2_DAT.WFM; press To Ref3 active/empty (side).
5. Press the MORE front-panel button, and then Ref3 (main) to display the waveform. Use the Vertical Position knob to center the reference waveforms. Figure 2–18 shows the J1V2_DAT.WFM recalled to Ref3.

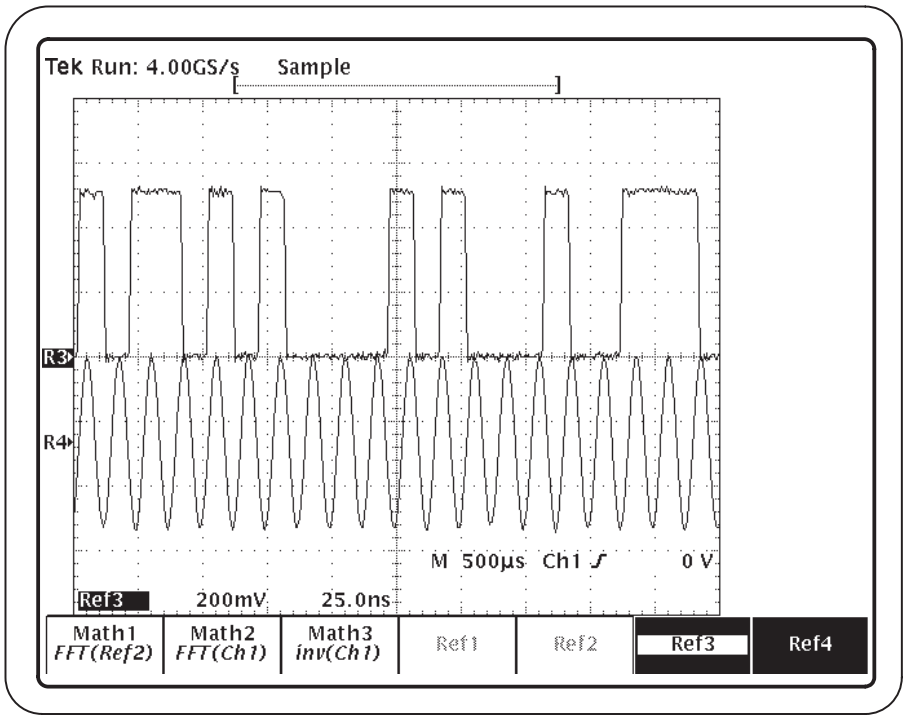



**Figure 2–18: J1V2_CLK.WFM recalled to Ref3**

6. Press the SHIFT, and then the APPLICATION front-panel menu button to return to the application.

To set up the application to take a Clock-to-Output Time measurement, follow these steps:

1. Press Meas Setup (main) → Select Measurement (side) → –more– 1 of 2 (side) → Clock-Data (side) → Clock Out (side), and select On.
2. Press Done (side) two times.
3. Press Select Active Meas (side) and use the GP knob to select Clock-to-Output Time in the list of selected measurements. Figure 2–19 shows the list of selected measurements.

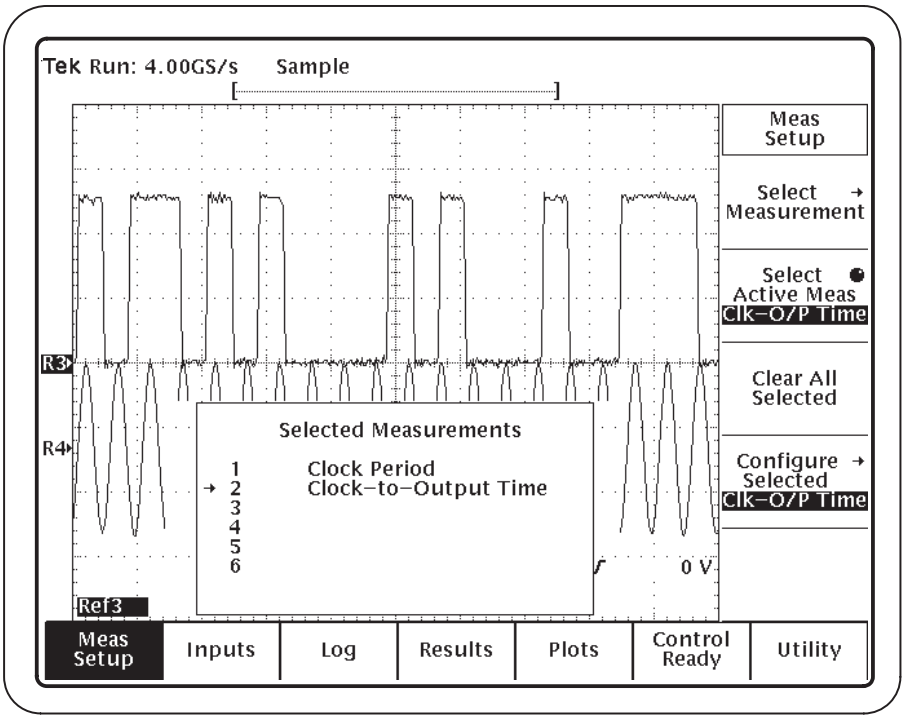



**Figure 2–19: Selected Measurements list**

4. Select Inputs (main) → 2nd (side) → Source (side) → –more– 1 of 4 (side) → –more– 2 of 4 (side) → Ref 3 (side).
5. Press Done (side) two times. Figure 2–20 shows the 2nd Input menu setup.

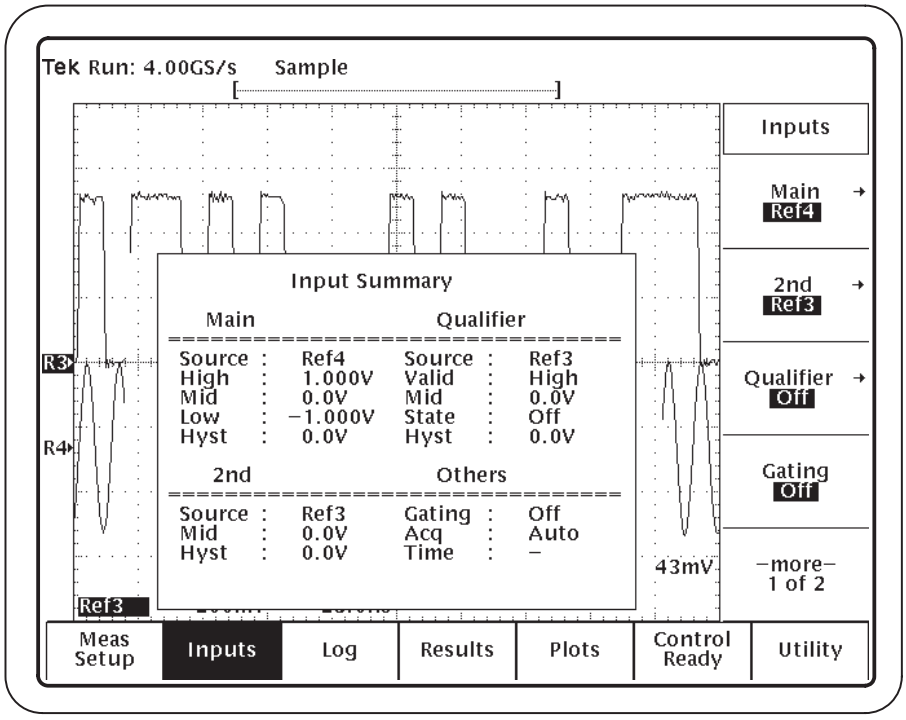



**Figure 2–20: 2nd Input menu setup**

6. To reset previous results to zero, press Control (main) → Reset Results (side).

7. To take the measurement, press Control (main) → Start (side).

   Wait for the calculations to complete. Figure 2–11 shows the results.

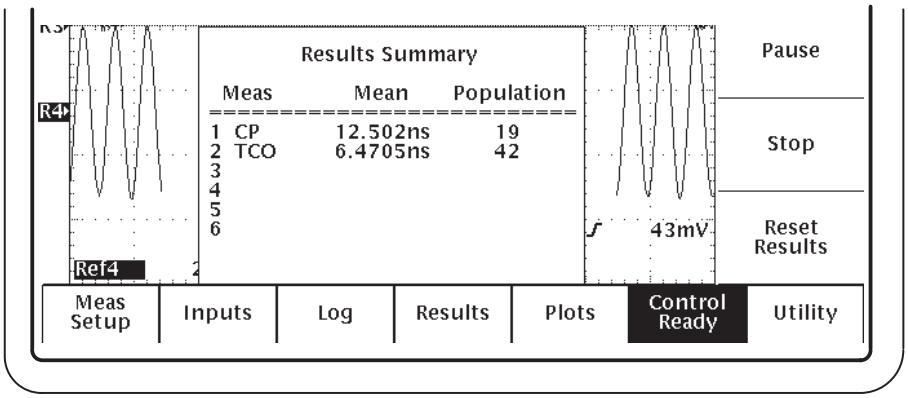



**Figure 2–21: Clock Out Time lesson: Results Summary results**

8. Press Results (main) → Result Details (side). Figure 2–22 shows the Results Details readout.

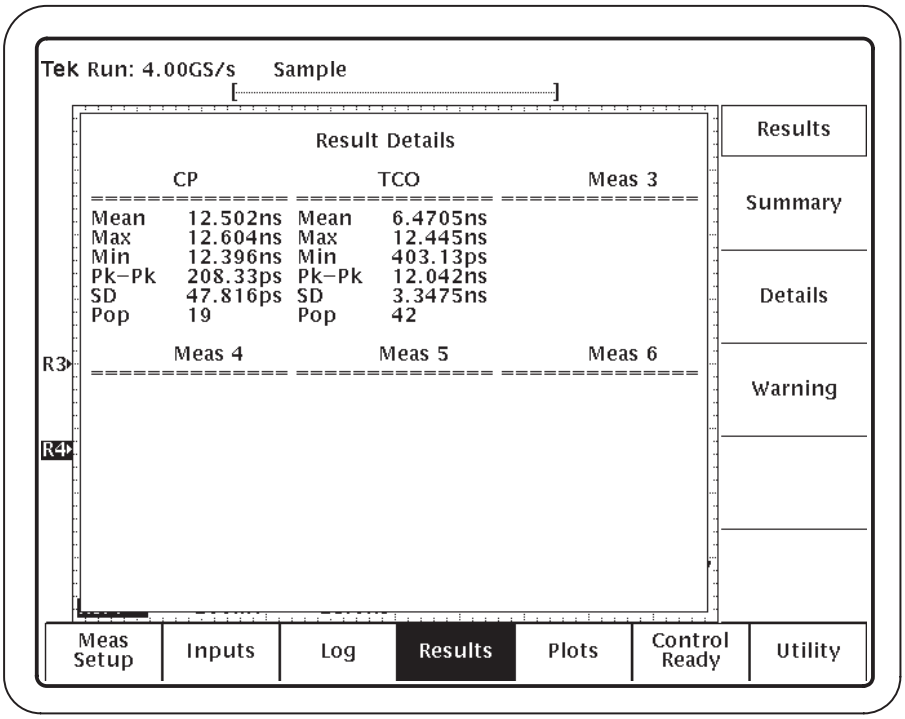



**Figure 2–22: Result Details shows the statistical values for all measurements**

## Saving the Results to a Data Log File

To save the measurement results to a data log file, follow these steps:

1. Press Log (main) → Log Results (side) and select On.
2. Press Done (side). Figure 2–23 shows the Log Results menu.

***NOTE.*** *The RESULTS.CSV file is stored on the hard disk drive by default. It is faster to save data to a log file on the hard disk drive than to a floppy disk.*

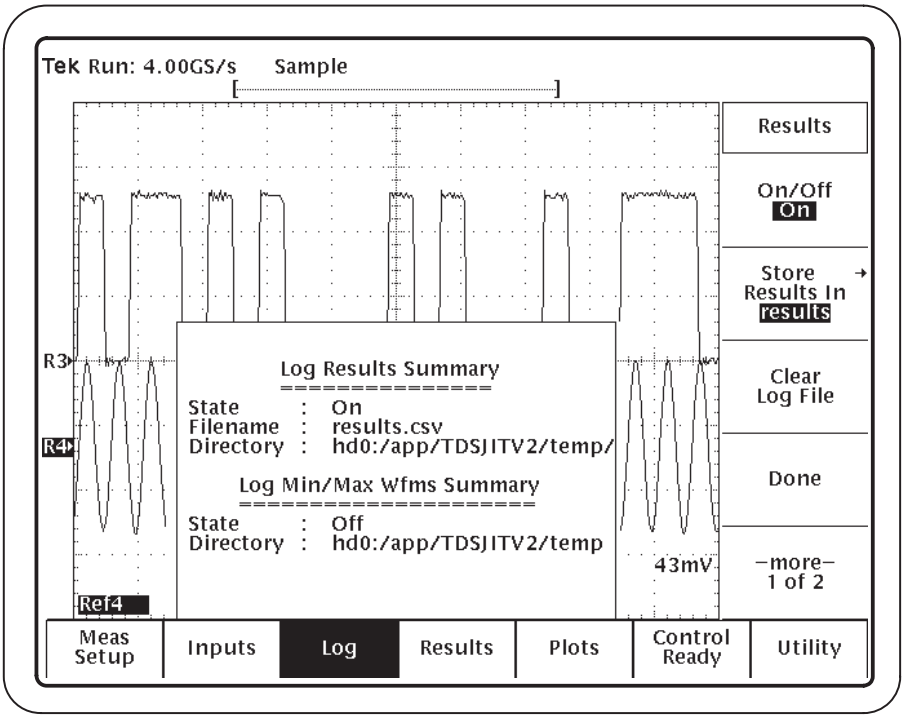



**Figure 2–23: Log Results menu**

**3.** To log the results to a .CSV file, press Control (main) → Start (side).

The "comma separated variable" file format (.CSV) is compatible with many spreadsheet, database, and data analysis programs on a personal computer.

**4.** After the measurement completes, press Control (main) → Start (side) to log more data to the RESULTS.CSV file.

**5.** To copy the RESULTS.CSV file to a floppy disk to view on a personal computer, follow these steps:

**a.** Insert a blank, DOS-formatted floppy disk into the floppy disk drive on the oscilloscope.

**b.** Press SAVE/RECALL SETUP → File Utilities (main).

**c.** Use the GP knob to highlight hd0:, and press SELECT.

**d.** Use the GP knob to highlight APP, and press SELECT.

**e.** Use the GP knob to highlight TDSJIT1V2, and press SELECT.

**f.** Use the GP knob to highlight TEMP, and press SELECT.

Figure 2–24 shows the RESULTS.CSV file and the path to it.

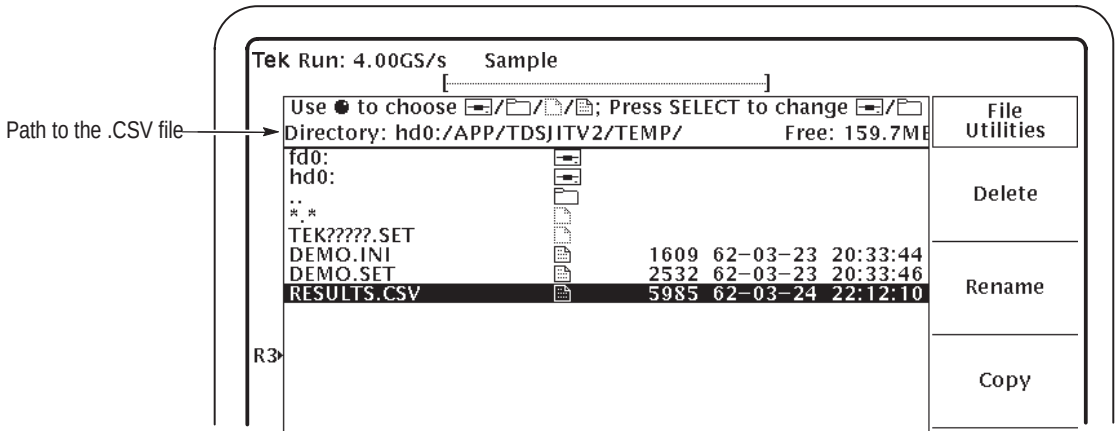



**Figure 2–24: Path to the RESULTS.CSV file on the hard drive**

**g.** Use the GP knob to highlight RESULTS.CSV, and press Copy (side).

**h.** Use the GP knob to highlight fd0:, and press Copy RESULTS.CSV to selected directory (side). Figure 2–25 shows this side menu item.

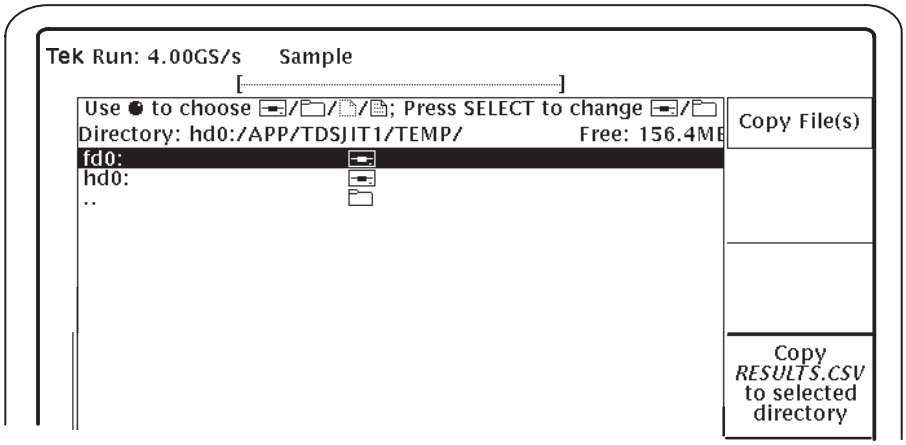



**Figure 2–25: Copying the RESULTS.CSV file to a floppy disk**

**6.** Press the SHIFT, and then the APPLICATION front-panel menu button to return to the application.

**7.** Eject and remove the floppy disk from the floppy disk drive.

## Viewing the RESULTS.CSV File (Data Log)

You can import the RESULTS.CSV file to a DOS-based personal computer and then view the data log file with a spreadsheet, database, or data analysis program. Figure 2–4 on page 2–15 shows an example of how the RESULTS.CSV file might look in a spreadsheet program on a personal computer.

## Stopping the Tutorial

If you need more than one session to complete the tutorial lessons, you can stop the tutorial and return to it another time. To do so, you will need to save the application and oscilloscope setups.

To save the setups and stop your session, refer to *Saving a Setup* on page 2–24 and to *Exiting the Application* on page 2–25.

## Returning to the Tutorial

To return to the tutorial setup, you can start the application and then recall the saved application and oscilloscope setups from within the application.

To recall the application and oscilloscope setups, refer to *Recalling a Setup* on page 2–25.

# GPIB Program Example

This section contains an example of a GPIB program that can execute the TDSJIT1V2 application. The application floppy disk contains this program in the tdsjit1ctrl.c file.

## Guidelines

Your GPIB program should comply with the following guidelines:

- Turn off the GPIB response headers with the "HEADER OFF" command; refer to the programmer information (in online help) for your oscilloscope.
- The application startup must complete before sending additional GPIB commands to the application (see example).
- The measurements cycle must complete before data is queried (see example).
- The error variable should be checked to ensure that an error has not occurred because of a measurement command problem.

## Program Example

This example shows how a GPIB program might execute the application to do the following tasks:

- Start the application
- Recall a setup
- Enable the logger
- Take a measurement
- Check for an error
- Exit the application

Refer to *Appendix B: GPIB Command Syntax* for a complete list of the GPIB command syntax with the arguments, variables, and variable values.

```
/* TDSJITV2
 * This is a reference program to illustrate how to communicate to TDSJIT1V2
 * using Remote GPIB facilities.

     Typical Application does following steps

     1. Start up the application
     2. Recall a setup
     4. Take a measurement
     5. Display results or errors
     6. Exit the application

     For the current program, we will recall "Default" settings (This has only one active
     measurement - Clock Period).

     You can save setup files according to your own needs using the application interface.

 */



#ifdef __cplusplus
extern "C"{
#endif
#include <windows.h>
#include <stdio.h>
#include <stdlib.h>
#include "decl-32.h"
#ifdef __cplusplus
}
#endif


/* Forward Declarations */
int start_application(int scope);
int exit_application(int scope);
int do_single_test (int scope);
int recall_setup( int scope, char *filename);
void display_results(int scope);


// parameters needed to access the device driver handler

#define BDINDEX               0     // Board Index
#define PRIMARY_ADDR_OF_DMM   1     // Primary address of device
#define NO_SECONDARY_ADDR     0     // Secondary address of device
#define TIMEOUT               T10s  // Timeout value = 10 seconds
#define EOTMODE               1     // Enable the END message
#define EOSMODE               0     // Disable the EOS mode
```

```
//char ReadBuffer[100];   //   Read data buffer
char ErrorMnemonic[21][5]  =  {"EDVR", "ECIC", "ENOL", "EADR", "EARG",
                               "ESAC", "EABO", "ENEB", "EDMA", "",
                               "EOIP", "ECAP", "EFSO", "", "EBUS",
                               "ESTB", "ESRQ", "", "", "", "ETAB"};


/*
 * After each GPIB call, the application checks whether the call
 * succeeded. If an NI-488.2 call fails, the GPIB driver sets the
 * corresponding bit in the global status variable. If the call
 * failed, this procedure prints an error message, takes
 * the device offline and exits.
 */
void GPIBCleanup(int ud, char* ErrorMsg)
{
   printf("Error : %s\nibsta = 0x%x iberr = %d (%s)\n",
           ErrorMsg, ibsta, iberr, ErrorMnemonic[iberr]);
   if (ud != -1)
   {
      printf("Cleanup: Taking device offline\n");
       ibonl(ud, 0);
   }
   exit(0);
}



/* Start Jitter Analysis application */

int start_application( int scope ) {
     char write_buffer[100];
     char read_buffer[100];
     char app_name[] = "\"TDSJITV2\"\n";
     int status, timer;

     /* Start the application */
     sprintf(write_buffer, "%s", "Application:activate \"hd0:/TDSJITV2.APP\"");
     status = ibwrt(scope, write_buffer, strlen(write_buffer));

     if (ibsta & ERR){
   GPIBCleanup(scope, "Unable to start the application");
       return 0;
   }

     timer = 1;

     while (1) {
        // Check whether application has started
        sprintf(write_buffer, "%s", "Variable:value? \"application\"");
        status = ibwrt(scope, write_buffer, strlen(write_buffer));
        status = ibrd(scope, read_buffer, sizeof(read_buffer));
        read_buffer[ibcnt] = '\0';
```

```
        if (strcmp(app_name, read_buffer) == 0) {
             return 1;
        }

        timer++;
        if (timer > 60) {
             return 0;
        }

        Sleep(1000);
      }
      return 1;

}


int exit_application(int scope) {
      char write_buffer[100];

      printf("Exit Application ...\n");
      sprintf(write_buffer, "%s", "Variable:value \"application\",\"exit\"");
      ibwrt(scope, write_buffer, strlen(write_buffer));

      return 1;

}



int recall_setup(int scope, char* filename) {

      char write_buffer[100];
      char readBuffer[100];
      int status;
      int timer;

      /* set Recall file name */
      sprintf(write_buffer, "%s%s%s", "Variable:value \"recallName\",\"", filename, "\"");
      status = ibwrt(scope, write_buffer, strlen(write_buffer));

      if (ibsta & ERR){
   GPIBCleanup(scope, "Unable to communicate with Scope");
       return 0;
   }


      /* recall setup */
      sprintf(write_buffer, "%s", "Variable:value \"setup\",\"Recall\"");
      status = ibwrt(scope, write_buffer, strlen(write_buffer));

      if (ibsta & ERR){
   GPIBCleanup(scope, "Unable to communicate with Scope");
       return 0;
   }
```

```
     /* Check whether recall is complete or not...If recall is complete
     variable setup value will change to a blank string */
     timer  = 1;

     while (1) {

        if (timer > 60) {
             return 0;
        }
        sprintf(write_buffer, "%s", "Variable:value? \"setup\"");
        ibwrt(scope, write_buffer, strlen(write_buffer));
        /* read the answer */
        ibrd(scope, readBuffer, 99);

        if (ibsta & ERR) {
             GPIBCleanup(scope, "Unable to write to device");
        }

        readBuffer[ibcnt] = '\0';

        if (strcmp(readBuffer,"\" \"\n") == 0) {
             return 1;
        }

        Sleep(1000);

     }
     return 1;
}



int do_single_test (int scope){
     char write_buffer[100];
     char read_buffer[100];

     int timer;

     sprintf(write_buffer, "%s", "Variable:value \"sequencerState\",\"Sequencing\"");
     ibwrt(scope, write_buffer, strlen(write_buffer));

     printf("Executing Test...\n");
     Sleep(100);

     // Wait for application to come to Ready State
     timer  = 1;

     while (1) {

        if (timer > 90) {
             printf("******Test Time Out ******\n");
             return 0;
        }
        sprintf(write_buffer, "%s", "Variable:value? \"sequencerState\"");
        ibwrt(scope, write_buffer, strlen(write_buffer));
        /* read the answer */
```

```
        ibrd(scope, read_buffer, 99);

        if (ibsta & ERR) {
             GPIBCleanup(scope, "Unable to write to device");
        }

        read_buffer[ibcnt] = '\0';

        if (strcmp(read_buffer,"\"Ready\"\n") == 0) {
             printf("Test Complete ...\n");
             return 1;
        }

        Sleep(1000);
      }

}


void display_results(int scope) {

      char write_buffer[100];
      char read_buffer[100];

      // Check for errors
      sprintf(write_buffer, "%s", "Variable:value? \"error\"");
      ibwrt(scope, write_buffer, strlen(write_buffer));

      /* read the answer */
      ibrd(scope, read_buffer, 99);

      if (ibsta & ERR) {
        GPIBCleanup(scope, "Unable to write to device");
      }
      read_buffer[ibcnt] = '\0';

      if (strcmp(read_buffer,"\" \"\n") != 0) {
        printf("Error has Occured. Error: %s\n",read_buffer);
        return;
      }

      // If no error, check for results
      sprintf(write_buffer, "%s", "Variable:value \"resultFor\",\"CP\"");
      ibwrt(scope, write_buffer, strlen(write_buffer));

      Sleep(2000);
      printf("\tClock Period Results\n");
      // ******** Mean
      sprintf(write_buffer, "%s", "Variable:value? \"mean\"");
      ibwrt(scope, write_buffer, strlen(write_buffer));

      /* read the answer */
      ibrd(scope, read_buffer, 99);
      read_buffer[ibcnt] = '\0';

      printf("mean:%s\n", read_buffer);
```

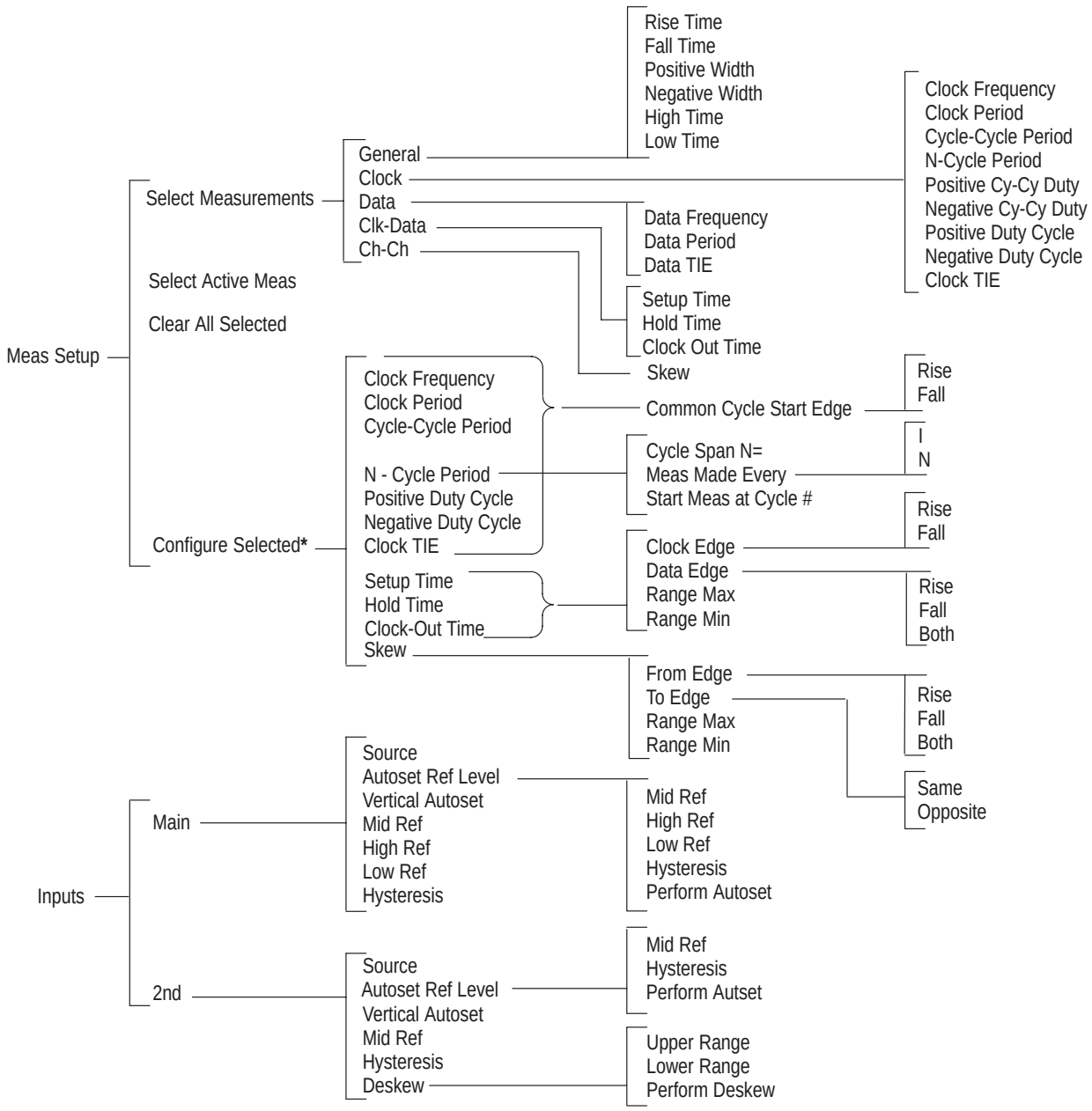
```
      // ******** Max
      sprintf(write_buffer, "%s", "Variable:value? \"max\"");
      ibwrt(scope, write_buffer, strlen(write_buffer));
      ibrd(scope, read_buffer, 99);
      read_buffer[ibcnt] = '\0';
      printf("max:%s\n", read_buffer);

      // ******** Min
      sprintf(write_buffer, "%s", "Variable:value? \"min\"");
      ibwrt(scope, write_buffer, strlen(write_buffer));
      ibrd(scope, read_buffer, 99);
      read_buffer[ibcnt] = '\0';

      printf("min:%s\n", read_buffer);

      // ******** PkPk
      sprintf(write_buffer, "%s", "Variable:value? \"pkpk\"");
      ibwrt(scope, write_buffer, strlen(write_buffer));
      ibrd(scope, read_buffer, 99);
      read_buffer[ibcnt] = '\0';

      printf("pkpk:%s\n", read_buffer);

      // ******** stdDev
      sprintf(write_buffer, "%s", "Variable:value? \"stdDev\"");
      ibwrt(scope, write_buffer, strlen(write_buffer));
      ibrd(scope, read_buffer, 99);
      read_buffer[ibcnt] = '\0';

      printf("stdDe:v%s\n", read_buffer);

      // ******** population
      sprintf(write_buffer, "%s", "Variable:value? \"population\"");
      ibwrt(scope, write_buffer, strlen(write_buffer));

      /* read the answer */
      ibrd(scope, read_buffer, 99);
      read_buffer[ibcnt] = '\0';

      printf("population:%s\n", read_buffer);

}


int main(){

      int Dev, i;
      char write_buffer[100];
      int status;

      Dev = ibdev (BDINDEX, PRIMARY_ADDR_OF_DMM, NO_SECONDARY_ADDR,
          TIMEOUT, EOTMODE, EOSMODE);
```

```
      if (ibsta & ERR){
         GPIBCleanup(Dev, "Unable to open device");
      } else {
         printf("My device id - %i", Dev);
      }


      sprintf(write_buffer, "%s", "header off");
      status = ibwrt(Dev, write_buffer, strlen(write_buffer));

      if (start_application(Dev)) {
         printf("\nApplication started....\n");
      }

      recall_setup(Dev, "Default");

      do_single_test(Dev);

      // Print the results
      display_results(Dev);

      exit_application(Dev);
      /* leave the device back elegantly */
      printf("Cleanup: Taking device offline\n");
      ibonl(Dev, 0);

}
```

# Reference

# Menu Structure

Figure 3–1 shows the relationship of the application-specific menus.




*** There is no configuration for the Rise Time, Fall Time, Positive Width, Negative Width, High Time, Low Time, Positive Cy - Cy Duty, Negative Cy - Cy Duty, Data Frequency, Data Period, and Data TIE measurements.**

**Figure 3–1: Menu structure**

Figure 3–2 shows the relationship of the remaining menus.

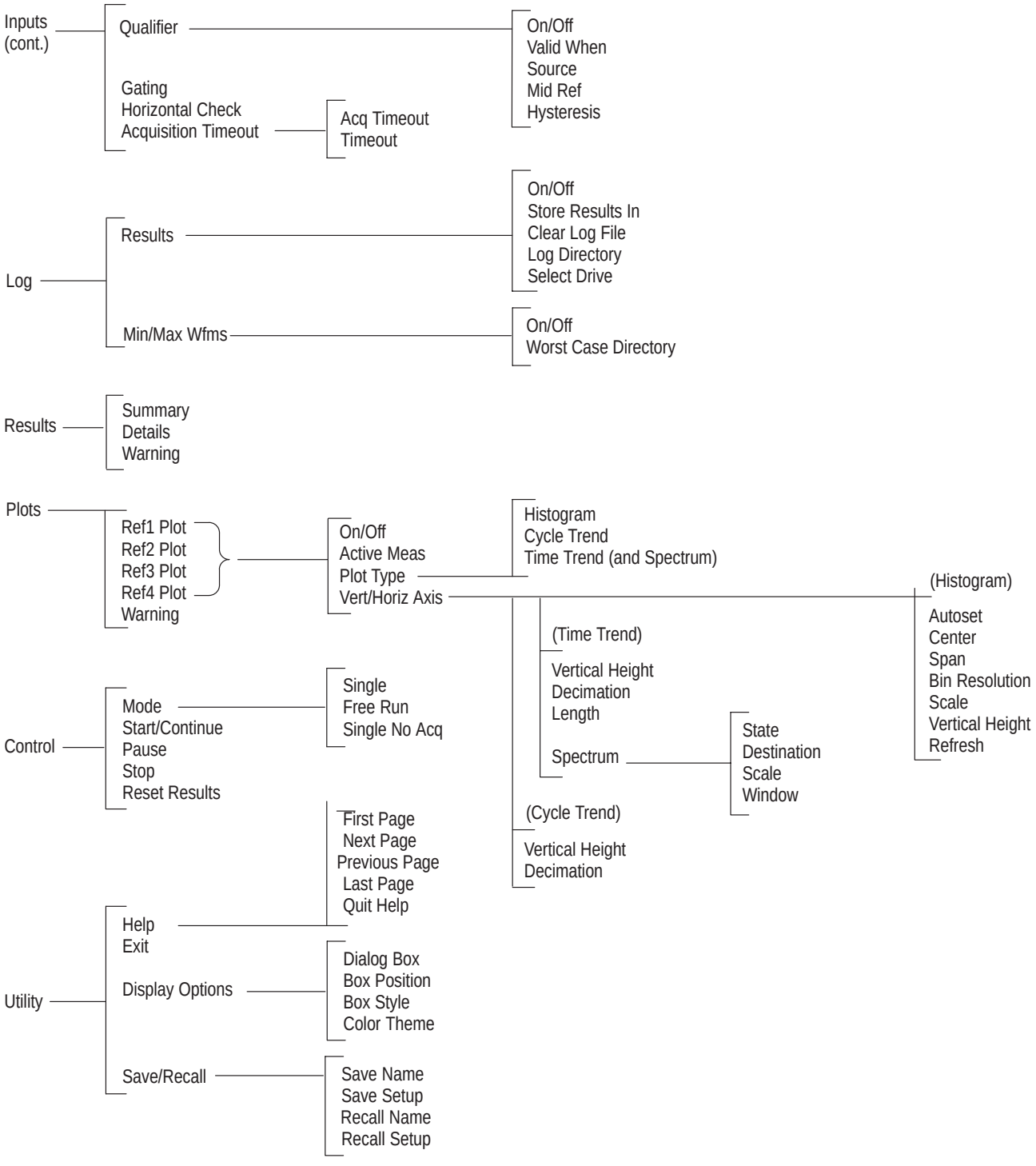



**Figure 3–2: Menu structure (continued)**

# Parameters

This section describes the TDSJIT1V2 application parameters. You should refer to the user manual for your oscilloscope for operating details of other controls, such as front-panel buttons.

Refer to *Appendix B: GPIB Command Syntax* for a complete list of the GPIB command syntax with the arguments, variables, and variable values that correspond to the TDSJIT1V2 parameters.

## Measurements Menus

There are two Meas Setup menus: Select Measurement, and Configure Selected, and two side menu items: Select Active Meas and Clear All Selected.

The Select Active Meas side menu item displays a list of up to six measurements activated in the Select Measurements menu. The selected active measurement is the measurement used as the Configure Selected item.

The Clear All Selected side menu item removes all activated measurements from the Select Active Meas side menu.

### Select Measurements Menu

The selections in the Select Meaurements menu by group are as follows:

- General group: Rise Time, Fall Time, Positive Width, Negative Width, High Time and Low Time
- Clock group: Clock Frequency, Clock Period, Cycle-Cycle Period, N-Cycle Period, Positive Cy-Cy Duty Cycle, Negative Cy-Cy Duty Cycle, Positive Duty Cycle, Negative Duty Cycle, Clock TIE
- Data group: Data Frequency, Data Period, and Data TIE
- Clock-Data group: Setup Time, Hold Time, and Clock Out
- Ch-Ch group: Skew

### Configure Selected Menu

You do not need to configure the following measurements:

- General group (all): Rise Time, Fall Time, Positive Width, Negative Width, High Time and Low Time
- Clock group: Positive Cy-Cy Duty and Negative Cy-Cy Duty
- Data group (all): Data Frequency, Data Period, and Data TIE

Table 3–1 lists the parameters for the Configure Selected menu and the selections or range of values available for each.

**Table 3–1: Configure Selected menu parameters**

| Parameter | Selections | Default setting |
|---|---|---|
| Common Cycle Start Edge | Rise, Fall | Rise |
| Cycle Span N= | 1 to 1,000 in 1 cycle units | 6 |
| Meas Made Every | 1, N | 1 |
| Start Meas at Cycle # | 1 to 1,000 in 1 cycle units | 1 |
| Common Data Cycle Edge | Rise, Fall, Both | Rise |
| Range Max | –500.0 ms to 500.0 ms in 10 ps units | 1.0 µs |
| Range Min | –500.0 ms to 500.0 ms in 10 ps units | 0 µs |
| From Edge | Rise, Fall, Both | Rise |
| To Edge | Same as From, Opposite as From | Same as From |
| Range Max* | –500.0 ms to 500.0 ms in 10 ps units | 1.0 µs |
| Range Min* | –500.0 ms to 500.0 ms in 10 ps units | –1.0 µs |

* **These range values are for the Skew measurement only.**

## Inputs Menus

There are four Inputs menus: Main Input, 2nd Input, Qualify Input, and Acquisition Timeout, and two side menu items: Gating, and Horizontal Check.

Gating makes cursors visible when you select On.

Horizontal Check checks if the Sample Rate is appropriate for the selected measurements; accurate measurements require at least two samples per edge.

Acquisition Timeout sets the amount of time that the application will wait to acquire data before it stops and displays an error message

### Main Input and 2nd Input Menus

Table 3–2 lists the parameters for the Main Input and 2nd Input menus and the selections or range of values available for each.

**Table 3–2: Main Input and 2nd Input menu parameters**

| Parameter | Selections | Default setting |
|---|---|---|
| Source | Ch1, Ch2, Ch3, Ch4, Ref1, Ref2, Ref3, Ref4, Math1, Math2, Math3* | Ch1 |
| Autoset Ref Levels | Refer to Table 3–3 | |
| Vertical Autoset | None | |
| Mid Ref | –9.99 V to 9.99 V in 0.01 V units | 0.00 V |
| High Ref** | –9.99 V to 10.0 V in 0.01 V units | 1.00 V |
| Low Ref** | –10.0 V to 9.99 V in 0.01 V units | –1.00 V |
| Hysteresis | 0 V to 5.0 V in 0.01 V units | 0.00 V |

*** When deskewing channels, only use Ch1, Ch2, Ch3, or Ch4.**

**** Only available for the waveform defined in the Main Input menu.**

Table 3–3 lists the parameters for the Autoset Ref Level menu and the selections or range of values available for each.

**Table 3–3: Autoset Ref Level menu parameters**

| Parameter | Selections | Default setting |
|---|---|---|
| Mid Ref | 1% to 99.0% in 1% units | 50% |
| High Ref** | 2% to 99.0% in 1% units | 90% |
| Low Ref* | 1% to 98.0% in 1% units | 10% |
| Hysteresis | 0% to 50.0% in 1% units | 3.0% |

*** Only available for the waveform defined in the Main Input menu.**

Table 3–3 lists the parameters for the Deskew menu and the selections or range of values available for each.

**Table 3–4: Deskew menu parameters**

| Parameter | Selections | Default setting |
|---|---|---|
| Upper Range | –1.0 sec to 1.0 sec in 1 ms units | 1.0 µs |
| Lower Range | –1.0 sec to 1.0 sec in 1 ms units | –1.0 µs |

***NOTE.*** *The Perform Deskew side menu item starts the deskew utility. Refer to* Deskewing the Probes and Channels *on page 1–4 for more information.*

### Qualifier Input Menu

Table 3–5 lists the parameters for the Qualifier Input menu and the selections or range of values available for each.

**Table 3–5: Qualifier Input menu parameters**

| Parameter | Selections | Default setting |
|---|---|---|
| On/Off | Off, On | Off |
| Valid When | Low, High | High |
| Source | Ch1, Ch2, Ch3, Ch4, Ref1, Ref2, Ref3, Ref4, Math1, Math2, Math3 | Ref3 |
| Mid Ref | –9.99 V to 9.99 V in 0.01 V units | 0.00 V |
| Hysteresis | 0 V to 5.0 V in 0.01 V units | 0.00 V |

### Acquisition Timeout Menu

Table 3–6 lists the parameters for the Acquisition Timeout menu and the selections or range of values available for each.

**Table 3–6: Acquisition Timeout menu parameters**

| Parameter | Selections | Default setting |
|---|---|---|
| Acq Timeout | Auto, User | Auto |
| Timeout | 0.1 hrs to 24 hrs in 0.1 hr units* | 0.1 hrs* |

* **When User is selected in the Acq Timeout side menu item.**

## Results Menus

There are no parameters for the Results Summary, Results Details, or Results Warning menus.

## Plot Menus

There are three Plot menus: Histogram, Cycle Trend, and Time Trend. The Spectrum plot is an FFT of the Time Trend plot and is accessed through the Time Trend plot menu.

## Histogram Plot Menu

Table 3–7 lists the parameters for the Histogram Plot menu and the selections or range of values available for each.

**Table 3–7: Histogram Plot menu parameters**

| Parameter | Selections | Default setting |
|---|---|---|
| Autoset | None | |
| Center | Refer to Table 3–8 | |
| Span | Refer to Table 3–8 | |
| Bin resolution | High, Medium, Low | Medium |
| Scale | Linear, Log (logarithmic) | Linear |
| Vertical Height | 1.0 V, 2.0 V, 3.0 V, 4.0 V | 4.0 V |

The parameters for the Horizontal Center and Horizontal Span vary by measurement. Table 3–8 lists the parameter selections and range of values.

**Table 3–8: Horizontal Center and Span parameters by measurement**

| Measurements | Parameter | Selections | Default setting |
|---|---|---|---|
| Rise Time, Fall Time, Positive Width, Negative Width, High Time, Low Time, Clock Period, and Data Period | Center | 10.0 ps to 1.0 s in units of 5 ps | 500 ms |
| | Span | 10.0 ps to 1.0 s in units of 5 ps | 1 s |
| Cycle-Cycle Period, N-Cycle Period, Positive Cy-Cy Duty, Negative Cy-Cy Duty, TIE, Data TIE, Setup Time, Hold Time, Clock Out Time, and Skew | Center | 0 s to 500.0 ms in units of 5 ps | 500 ms |
| | Span | 10.0 ps to 1.0 s in units of 5 ps | 1 s |
| Clock Frequency, Data Frequency | Center | 1 Hz to 1 GHz in units of 1 Hz | 500 MHz |
| | Span | 1 Hz to 1 GHz in units of 1 Hz | 1 GHz |
| Positive Duty, and Negative Duty | Center | 0% to 100% in units of 0.1% | 50% |
| | Span | 0% to 100% in units of 0.1% | 100% |

## Cycle Trend Menu

Table 3–7 lists the parameters for the Cycle Trend Plot menu and the selections or range of values available for each.

**Table 3–9: Cycle Trend Plot menu parameters**

| Parameter | Selections | Default setting |
|---|---|---|
| Vertical Height | 1.0 Div, 2.0 Div, 3.0 Div, 4.0 Div | 4.0 Div |
| Decimation | Off, On | Off |

**Table 3–9: Cycle Trend Plot menu parameters (Cont.)**

| Parameter | Selections | Default setting |
|---|---|---|
| Length | 500, 1000, 2500* | 500 |

* **Selections vary and depend on the oscilloscope model and the record length.**

## Time Trend Menu

Table 3–10 lists the parameters for the Time Trend Plot menu and the selections or range of values available for each.

**Table 3–10: Time Trend Plot menu parameters**

| Parameter | Selections | Default setting |
|---|---|---|
| Vertical Height | 1.0 Div, 2.0 Div, 3.0 Div, 4.0 Div | 4.0 Div |
| Decimation | Off, On | Off |
| Length | 500, 1000, 2500, 5000, 15000, 30000, 50000* | 500 |

* **Selections vary and depend on the oscilloscope model and the record length.**

***NOTE.*** *The Time Trend plot is limited to a 50,000 point record length; the Spectrum plot is limited to a 10,000 point record length.*

## Spectrum Menu

Table 3–11 lists the parameters for the Spectrum Plot menu and the selections or range of values available for each.

**Table 3–11: Spectrum Plot menu parameters**

| | | |
|---|---|---|
| State | On, Off | Off |
| Destination | Math1, Math2, Math3 | Math1 |
| Scale | dB, Linear | Linear |
| Window Data | On, Off | Off |

## Log Menus

There are two Log menus: Results and Min/Max Wfm.

### Results Menu

Table 3–12 lists the parameters for the Log Results menu and the selections or range of values available for each.

**Table 3–12: Log Results menu parameters**

| Parameter | Selections | Default setting |
|---|---|---|
| On/Off | On, Off | Off |
| Store Results In: | RESULTS.CSV, or new file name | RESULTS |
| Clear Log File | None | |
| Log Directory | | hd0:/app/TDSJITV2/temp |
| Select Drive | fd0, hd0 | hd0 |

### Min/Max Wfms Menu

Table 3–13 lists the parameters for the Log Min/Max Wfms menu and the selections or range of values available for each.

**Table 3–13: Log Min/Max Wfms menu parameters**

| Parameter | Selections | Default setting |
|---|---|---|
| On/Off | On, Off | Off |
| Min/Max Directory | | hd0:/app/TDSJITV2/temp |

## Control Menu

Table 3–14 lists the parameters for the Control menu and the selections available.

**Table 3–14: Control menu parameters**

| Parameter | Selections | Default setting |
|---|---|---|
| Mode | Single, Free Run, Single No Acq | Single |
| Start (or Continue) | None | |
| Pause | None | |
| Stop | None | |
| Reset Results | None | |

## Utility Menus

Table 3–15 lists each utility menu, the parameters, the selections available, and default settings.

**Table 3–15: Utility menus and parameters**

| Utility menu | Parameter | Selections | Default setting |
|---|---|---|---|
| Help | Refer to page 2–1 | None | |
| Exit | Refer to page 2–25 | None | |
| Display Options | Dialog Box | On, Off | On |
| | Box Position | Left, Middle, Right | Middle |
| | Box Style | Opaque, Transparent | Opaque |
| | Color Theme | Based on the TDS oscilloscope color selections | TDS Default |
| Save/Recall Setup | Save Name | asetup, or new file name | asetup |
| | Save Setup | None | |
| | Recall Name | Default, or saved setup file names | Default |
| | Recall Setup | None | |

# Appendices

# Appendix A: Measurement Algorithms

The TDSJIT1V2 application can take timing measurements from one or two waveforms. The number of waveforms used by the application depends on the type of measurement being taken.

Single waveform measurements are: Rise Time, Fall Time, Positive Width, Negative Width, High Time, Low Time, Clock Period, Clock Frequency, Cycle-Cycle Period, N-Cycle Period, Positive Cycle-Cycle Duty, Negative Cycle-Cycle Duty, Positive Duty Cycle, Negative Duty Cycle, Clock TIE, Data Period, Data Frequency, and Data TIE. Dual waveform measurements are: Setup Time, Hold Time, Clock-to-Output, and Skew.

## Oscilloscope Setup Guidelines

For all measurements, use the following guidelines to set up the oscilloscope:

1. The signal is any channel, reference, or math waveform.
2. The vertical scale for the waveform must be set so that the waveform does not exceed the vertical range of the oscilloscope.
3. The sample rate must be set small enough to capture sufficient waveform detail and avoid aliasing.
4. Longer record lengths increase measurement accuracy. However, you should be aware of the memory length limitations with Time Trend or Spectrum plots. For more information, refer to the procedures for viewing the results in a Time Trend or a Spectrum plot on page 2–19.

## Test Methodology

The application performs the measurement according to the following steps:

1. Imports the current waveform.
2. Checks that the reference voltage level plus or minus half the hysteresis are within the 2.5% to 97.5% range of the peak-to-peak waveform values.
3. Checks that there are a minimum number of edges in the waveform to calculate the measurement as follows:
   - Single edge: Rise Time, Fall Time
   - One edge pair: Pulse Width, High Time, Low Time

- Two cycle-start edges: Frequency, Period, Duty Cycle
- Three cycle-start edges: Cycle-Cycle, TIE
- 2N + 1 cycle-start edges: N-Cycle
- Two edges on each of two waveforms: Skew

4. Performs the measurement.
5. Displays the results as statistics, saves the results as a plot format in a reference waveform, or saves the results to a data log file.

## Edge-Timing Measurements

All timing measurements are based on the time locations of edges within each acquisition. Edge conditions are defined in the setup menu of each timing measurement. $T_n$ represents the acquisition edge times where *n* is an index between 1 and the number of edges in the acquisition.

The "i" and "j" represent dissimilar acquisition indices. Dissimilar acquisition indices occur when the correlation between clock edges and a data transitions are not one-to-one.

## Single Waveform Measurements

The Rise Time and Fall Time algorithms use both the VRefHi and VRefLo reference voltage levels. Each edge is defined by the slope, voltage reference level (threshold), and hysteresis.

### Rise Time Measurement

The Rise Time measurement is the time difference between when the VRefHi reference level is crossed and the VRefLo reference level is crossed on the rising edge of the waveform.

The application calculates this measurement using the following equation:

$$T_n^{Rise} = T_n^{Hi+} - T_n^{Lo+}$$

Where: $T^{Rise}$ is the rise time.

$T^{Hi+}$ is the VRefHi crossing on the rising edge.

$T^{Lo+}$ is the VRefLo crossing on the rising edge.

### Fall Time Measurement

The Fall Time measurement is the time difference between when the VRefLo reference level is crossed and the VRefHi reference level is crossed on the falling edge of the waveform.

The application calculates this measurement using the following equation:

$$T_n^{Fall} = T_n^{Lo-} - T_n^{Hi-}$$

Where: $T^{Fall}$ is the fall time.

$T^{Lo-}$ is the VRefLo crossing on the falling edge.

$T^{Hi-}$ is the VRefHi crossing on the falling edge.

### Positive and Negative Width Measurements

The Positive Width and the Negative Width measurements are the difference in time (positive or negative) between the leading edge and trailing edge of a pulse. The trailing edge is the opposite polarity (direction) of the leading edge.

The application calculates this measurement using the following equation:

$$W_n^+ = T_n^- - T_n^+$$

$$W_n^- = T_n^+ - T_n^-$$

Where: $W^+$ is the positive pulse width.

$W^-$ is the negative pulse width.

$T^-$ is the VRefMid crossing on the falling edge.

$T^+$ is the VRefMid crossing on the rising edge.

### High Time Measurement

The High Time measurement is the amount of time that a waveform cycle is above the VRefHi voltage reference level.

The application calculates this measurement using the following equation:

$$T_n^{Hi} = T_n^{Hi-} - T_n^{Hi+}$$

Where: $T^{Hi}$ is the high time.

$T^{Hi-}$ is the VRefHi crossing on the falling edge.

$T^{Hi+}$ is the VRefHi crossing on the rising edge.

### Low Time Measurement

The Low Time measurement is the amount of time that a waveform cycle is below the VRefLo voltage reference level.

The application calculates this measurement using the following equation:

$$T_n^{Low} = T_n^{Lo+} - T_n^{Lo-}$$

Where: $T^{Low}$ is the low time.

$T^{Lo+}$ is the VRefLo crossing on the rising edge.

$T^{Lo-}$ is the VRefLo crossing on the falling edge.

### Clock Frequency Measurement

The Clock Frequency measurement calculates the inverse of the clock period for each cycle.

The application calculates this measurement using the following equation:

$$F_n^{Clock} = 1/P_n^{Clock}$$

Where: $F^{Clock}$ is the clock frequency.

$P^{Clock}$ is the period.

### Clock Period Measurement

The Clock Period measurement calculates the duration of a cycle as defined by a start and a stop edge. Edges are defined by slope, threshold, and hysteresis.

The application calculates this measurement using the following equation:

$$P_n^{Clock} = T_{n+1} - T_n$$

Where: $P^{Clock}$ is the clock period.

$T$ is the VRefMid crossing time in the Common Cycle Start Edge direction.

### Cycle-Cycle Period Measurement

The Cycle-Cycle Period measurement calculates the difference in period measurements from one cycle to the next.

The application calculates this measurement using the following equation:

$$\Delta P_n = P_{n+1}^{Clock} - P_n^{Clock}$$

Where: $\Delta P$ is the difference between adjacent periods.

$P^{Clock}$ is the period.

### N-Cycle Period Measurement

The N-Cycle Period measurement calculates the difference in period measurements from cycles that are a defined number of cycles apart.

The application calculates this measurement using the following equation:

$$\Delta NP_n = \left(T^+_{n+2N} - T^+_{n+N}\right) - \left(T^+_{n+N} - T^+_n\right)$$

Where: $\Delta NP$ is the difference between adjacent N-cycle periods.

$T^+$ is the VRefMid crossing time in the Common Cycle Start Edge direction.

### Positive and Negative Cycle-to-Cycle Duty Measurements

The Positive Cycle-to-Cycle Duty and Negative Cycle-to-Cycle Duty measurements calculate the ratio of the positive (or negative) portion of the cycle relative to the period from one cycle to the next.

The application calculates this measurement using the following equation:

$$\Delta W^+_n = W^+_n - W^+_{n-1}$$
$$\Delta W^-_n = W^-_n - W^-_{n-1}$$

Where: $\Delta W^+$ is the positive cycle-to-cycle duty.

$\Delta W^-$ is the negative cycle-to-cycle duty.

$W^+$ is the positive pulse width.

$W^-$ is the negative pulse width.

### Positive and Negative Duty Cycle Measurements

The Positive Duty Cycle and Negative Duty Cycle measurements calculate the ratio of the positive (or negative) portion of the cycle relative to the period.

The application calculates this measurement using the following equation:

$$D^+_n = W^+_n / P^{Clock}_n$$
$$D^-_n = W^-_n / P^{Clock}_n$$

Where: $D^+$ is the positive duty cycle.

$D^-$ is the negative duty cycle.

$W^+$ is the positive pulse width.

$W^-$ is the negative pulse width.

$P^{Clock}$ is the period.

### Clock TIE Measurement

The Clock TIE measurement calculates the difference in time between the designated edge on a sampled clock waveform to the designated edge on a calculated clock waveform with a constant frequency (zero jitter).

The application calculates this measurement using the following equation:

$$TIE_n^{Clock} = T_n - T'_n$$

Where:

$TIE^{Clock}$ is the clock time interval error.

$T_n$ is the specified clock edge.

$T'_n$ is the calculated ideal clock edge.

### Data Frequency Measurement

The Date Frequency measurement calculates the inverse of the data period for each cycle.

The application calculates this measurement using the following equation:

$$F_n^{Data} = 1/P_n^{Data}$$

Where:

$F^{Data}$ is the data frequency.

$P$ is the period.

### Data Period Measurement

The Date Period measurement calculates the duration of a cycle as defined by a start and a stop edge. Edges are defined by slope, threshold, and hysteresis.

The application calculates this measurement using the following equation:

$$P^{Data} = \left(T_n^{Data} - T_{n-1}^{Data}\right)/(C_n - C_{n-1})$$

Where:

$P^{Data}$ is the data period.

$T^{Data}$ is the VRefMid crossing time in either direction.

$C_n$ is the calculated clock cycle location of $T^{Data}{}_n$.

### Data TIE Measurement

The Data TIE measurement calculates the difference in time between the designated edge on a sampled data waveform to the designated edge on a calculated data waveform with a constant frequency (zero jitter).

The application calculates this measurement using the following equation:

$$TIE_n^{Data} = T_n^{Data} - T_n^{Data'}$$

Where: $TIE^{Data}$ is the data time interval error.

$T^{Data}$ is the data edge, the VRefMid crossing time in either direction.

$T^{Data'}$ is the calculated ideal data edge time.

## Dual Waveform Measurements

Edge conditions are defined for two waveforms. These algorithms use the VRef values as the reference voltage level. Each edge is defined by the slope, voltage reference level (threshold), and hysteresis.

### Setup Time Measurement

The Setup Time measurement is the elapsed time between the designated edge of a data waveform and when the clock waveform crosses its own voltage reference level. The closest data edge to the clock edge that falls within the range limits is used.

The application calculates this measurement using the following equation:

$$T_n^{Setup} = T_i - T_n^{Data}$$

Where: $T^{Setup}$ is the setup time.

$T$ is the Main input (clock) $VRefMid_{Main}$ crossing time in the specified direction.

$T^{Data}$ is the 2nd input (data) $VRefMid_{2nd}$ crossing time in the specified direction.

### Hold Time Measurement

The Hold Time measurement is the elapsed time between when the clock waveform crosses its own voltage reference level and the designated edge of a data waveform. The closest data edge to the clock edge that falls within the range limits is used.

The application calculates this measurement using the following equation:

$$T_n^{Hold} = T_n^{Data} - T_i$$

Where: $T^{Hold}$ is the hold time.

$T$ is the Main input (clock) $VRefMid_{Main}$ crossing time in the specified direction.

$T^{Data}$ is the 2nd input (data) $VRefMid_{2nd}$ crossing time in the specified direction.

### Clock Out Time Measurement

The Clock Out Time (clock to output) measurement is the elapsed time between when the clock waveform crosses its own voltage reference level and the designated edge of a data waveform. The closest data edge to the clock edge that falls within the range limits is used.

The application calculates this measurement using the following equation:

$$T_n^{ClkOut} = T_n^{do} - T_i$$

Where: $T^{ClkOut}$ is the clock-to-output time.

$T$ is the Main input (clock) $VRefMid_{Main}$ crossing time in the specified direction.

$T^{do}$ is the 2nd input (data) $VRefMid_{2nd}$ crossing time in the specified direction.

### Skew Measurement

The Skew measurement calculates the difference in time between the designated edge on a principle waveform to the designated edge on another waveform. The closest data edge to the clock edge that falls within the range limits is used.

The application calculates this measurement using the following equation:

$$T_n^{Skew} = T_n - T_n^S$$

Where: $S$ is the period.

$T$ is the Main input $VRefMid_{Main}$ crossing time in the specified direction.

$T^S$ is the 2nd input $VRefMid_{2nd}$ crossing time in the specified direction.

# Appendix B: GPIB Command Syntax

This appendix describes the GPIB command syntax that you can use in your GPIB program to do the following tasks:

- Start the TDSJIT1V2 application
- Recognize an active application with GPIB protocol
- Program and read application setup parameters
- Sequence measurements
- Synchronously read measurement results

To use GPIB commands with your oscilloscope, you can use the following reference materials:

- The tdsjit2ctrl.c file on floppy disk for an example of a GPIB program that can execute the application
- The *GPIB Program Example* section for guidelines to use while designing a GPIB program
- The *Parameters Reference* section for incremental units and default values of TDSJIT1V2 parameters

**Description.** Gives the function of the command, conditions of its use, and its interactions with other commands.

**Syntax.** Gives the valid select and query command forms. The required arguments are listed in their proper order.

For example, in the syntax definition

```
PATH= <Ad><Ars>
```

```
the arguments <Ad> and <Ars> are required in the order indicated
```

**Arguments.** The arguments to a command are defined along with their range of values.

**Returns.** Defines the data returned in response to a command query.

# VARIABLE:VALUE TDS COMMAND

**Description** VARIABLE:VALUE TDS COMMAND accepts string arguments for a control or data variable and a value to which to set the argument.

**Syntax** VARIABLE:VALUE

```
VARIABLE:VALUE "<variable name>","<variable value>"

the arguments <variable name> and <variable value> are required
in the order indicated.

VARIABLE:VALUE? "<variable name>" for query
```

**Arguments and Returns** Table B–1 lists the arguments, their function, and the query returns.

**Table B–1: VARIABLE:VALUE TDS COMMAND arguments and queries**

| Variable name | Variable value | Function | Query form |
|---|---|---|---|
| application | {activate "hd0:/TDSJITV2.APP", exit} | Activates the application or terminates the active application | Returns the name of the currently active application |
| **Sequencer** | | | |
| sequenceMode | {Single_NoAcq, FreeRun, Single} | Sets the sequencer mode | Returns the sequencer mode |
| sequencerState | {Ready, Paused, Sequencing} | Sets the state of the sequencer: Sequencing, Ready, Paused | Returns the state of the sequencer |
| **Save/Recall** | | | |
| setup | {Default, Recall, Save} | Sets the Save/Recall/Default action | No query form |
| recallName | Any string from 1 to 8 characters from A to Z and/or zero to nine | Sets the recalled setup file name | Returns the saved setup file name |
| saveName | Any string from 1 to 8 characters from A to Z and/or zero to nine | Sets setup file name | Returns the setup file name |
| **Logging Results** | | | |
| logAnnotate* | Any string from 1 to 20 characters from A to Z and/or zero to nine | Provides custom annotation to the statistics log file | No query form |
| loggerDestination | Any string from 1 to 8 characters from A to Z and/or zero to nine | Sets the statistics log file name | Returns the statisics log file name |
| logDirectory | {Default} | Sets the directory to the default directory | No query form |
| logger | {Reset} | Clears the current statistics log file | No query form |

**Table B–1: VARIABLE:VALUE TDS COMMAND arguments and queries (Cont.)**

| Variable name | Variable value | Function | Query form |
|---|---|---|---|
| loggerState | {On, Off} | Sets the state of the statistics log; when on, the statistics from the current acquisition are logged | Returns the state of the data log |
| **Result Variables** | | | |
| resultFor | {CF, CP, TIE, CCP, NCP, PCCD, NCCD, PDC, NDC, PW, NW, RISE, FALL, HIGH, LOW, DF, DP, DTIE, SU, HOLD, TCO, SKEW} | Sets the measurement for which results are requested | See Table B–2 |

*** Custom annotation in the data log file is only available through GPIB execution of the application.**

Table B–2 lists the measurement results queries.

**Table B–2: Measurement results queries**

| Variable name | Function |
|---|---|
| calcFrequency | Returns the calculated frequency of the result for the measurement selected in the resultFor variable |
| error | Returns the error, if any, from the last measurement taken |
| max | Returns the maximum value of the result for the measurement selected in the resultFor variable |
| mean | Returns the mean value of the result for the measurement selected in the resultFor variable |
| min | Returns the minimum value of the result for the measurement selected in the resultFor variable |
| pkpk | Returns the peak-to-peak value of the result for the measurement selected in the resultFor variable |
| population | Returns the population for the result for the measurement selected in the resultFor variable |
| positiveMax | Returns the positive maximum value for the result of the measurement selected in the resultFor variable |
| positiveMean | Returns the positive mean value of the result for the measurement selected in the resultFor variable |
| positivePopulation | Returns the positive population for the result for the measurement selected in the resultFor variable |
| negativePopulation | Returns the negative population for the result for the measurement selected in the resultFor variable |
| negativeMax | Returns the negative maximum value of the result for the measurement selected in the resultFor variable |

**Table B–2: Measurement results queries (Cont.)**

| Variable name | Function |
|---|---|
| negativeMean | Returns the negative mean value of the result for the measurement selected in the resultFor variable |
| stdDev | Returns the standard deviation value of the result for the measurement selected in the resultFor variable |
| warning | Returns the warning, if any, from the last measurement taken |

# Appendix C: Error Codes

This appendix describes the error codes that display when there is a problem with operating the application. Table C–1 lists the codes with a brief description of each and a possible solution.

***NOTE**. Be sure to deskew the probes and oscilloscope channels before taking jitter measurements. (Refer to* Deskewing the Probes and Channels *on page 1–4.) You may encounter problems that cause the application to display error codes because the probes and channels are not deskewed.*

**Table C–1: Error codes, descriptions and solutions**

| Number | Description | Solution |
|---|---|---|
| E001/E108 | No measurement selected | Select a measurement in the Measure menu and acquire data |
| E002 | No valid edge found at the data source | If using Single mode, reacquire data; if the application still cannot find a valid edge, change to Free Run mode and acquire data |
| E003 | No valid edge found at the data destination | Same solution as E002 |
| E004 | Association of edges failed | Unable to associate the data signals with the clock signals; this may indicate an SUT (system under test) problem with time synchronization between the signals; also try solution for E002 |
| E005 | Search for edges terminated; waveform segment is too short | The application requires a minimum waveform length of two records; if the length of the acquired waveform is less than two, increase the record length and acquire data |
| E006 | Too many edges; sampling frequency is too low | The application cannot accurately reconstruct the waveform; use the HORIZONTAL SCALE knob to decrease the horizontal scale and acquire data |
| E007 | The waveform is above the hysteresis because the level is too low; the waveform does not cross the hysteresis and remains above it | Increase the level of the waveform; select Inputs (main) → (a waveform)(side) → Mid Ref (side) and turn the GP knob towards the right |
| E008 | The waveform is below the hysteresis because the level is too high; the waveform does not cross the hysteresis and remains below it | Decrease the level of the waveform; select Inputs (main) → (a waveform)(side) → MidRef (side) and turn the GP knob towards the left |
| E009 | The level is too high and the waveform does not cut into the upper boundary of the hysteresis | Increase the hysteresis of the waveform; select Inputs (main) → Hysteresis (side) and turn the GP knob towards the right or try the same solution as E008. |
| E010 | The level is too low and the waveform does not cut into the lower boundary of the hysteresis | Decrease the hysteresis of the waveform; select Inputs (main) → Hysteresis (side) and turn the GP knob towards the left or try the same solution as E007. |
| E011 | Hysteresis band is not within the central 95% peak-to-peak | Decrease the hysteresis of the waveform; select Inputs (main) → Hysteresis (side) and turn the GP knob towards the left |

**Table C–1: Error codes, descriptions and solutions (Cont.)**

| Number | Description | Solution |
|---|---|---|
| E012 | VRefHi value is not appropriate | Check the VRefHi value; it should be more than the VRefLo value and the Level (VRefMid) value |
| E013 | VRefLo value is not appropriate | Check the VRefLo value; it should be less than the VRefHi value and the Level (VRefMid) value |
| E014 | Failed to import a waveform and sequencing stopped | The application did not acquire the waveform; check the connection of the live signal to the channel or check the reference memory to be sure that it contains the appropriate waveform |
| E101 | Failed to acquire a signal; not able to trigger | Check that the signal is present and make sure that Trigger Settings are correct |
| E102 | Failed to import the waveform | The application did not acquire the waveform; check the connection of the live signal to the channel or check the reference memory to be sure that it contains an appropriate waveform |
| E103 | Record length changed between acquisitions | The record length was changed while the application was taking measurements; do not change any oscilloscope settings after the application starts taking measurements |
| E104 | Not enough edges on the Qualifier Input | If you use Ch1, Ch2, Ch3, or Ch4 as the qualifier, increase the HORIZONTAL SCALE and/or increase the record length on the oscilloscope (HORIZONTAL MENU → Record Length (main) → select larger value); if the qualifier is a waveform recalled to a reference memory, then use a different waveform that has more edges |
| E105 | Failed to enable the sources | No waveform is available as the source; if you are using a reference memory as an input, make sure that a waveform is recalled to the specified reference memory and that it is displayed |
| E106 | Not enough edges to preform deskew | Increase the HORIZONTAL SCALE and/or increase the record length on the oscilloscope (HORIZONTAL MENU → Record Length (main) → select larger value) |
| E107/E109 | Cannot deskew reference or math waveforms | Deskew works only on Ch1, Ch2, Ch3, and Ch4; change the source as appropriate in the Main Input and 2nd Input menus |
| E110 | Qualifier Input and Gating are mutually exclusive | Check that either the Qualifier Input or Gating are enabled, not both |
| E201 | Not enough edges for the application to take measurments | Increase the HORIZONTAL SCALE and/or increase the record length on the oscilloscope (HORIZONTAL MENU → Record Length (main) → select larger value) |
| E202 | Upper Range must be greater than Lower Range | Verify that appropriate values are selected for the Upper Range and Lower Range side menu items |
| E301 | Conflict found in the use of waveforms | Check if the waveform is used in more than one Input or Plot menu; if need be, disable the Input or Plot menu or change the selected waveform, and then select the waveform for the desired function |
| E302 | Cannot enable a plot | Not able to plot the results because the length of the plot is greater than 50000, or there is not enough memory available; decrease the record length or enable Decimation |

**Table C–1: Error codes, descriptions and solutions (Cont.)**

| Number | Description | Solution |
|---|---|---|
| E401 | No valid waveform present | Check the connection of the signals to CH 1, CH 2, CH 3, or CH 4 on the oscilloscope, or check if appropriate waveforms are recalled to the reference memories |
| E601 | Cannot save Min/Max waveform files to disk | The oscilloscope cannot write to a file because the disk is full, the disk is write-protected, or the disk is bad |
| E701 | Cannot save the data log file to disk | The oscilloscope cannot write to a file because the disk is full, the disk is write-protected, or the disk is bad |
| E801 | Oscilloscope is not compatible | Application runs only on TDS694C, TDS784D, and TDS794D oscilloscopes |
| E802 | RTE must be V1.2 and above | Check if the RTE Version of the Oscilloscope is greater than or equal to Version 1.2. If not, the Aplication is not compatible with the Oscilloscope. |
| E901 | Time Trend plot must be equal to or less than 10,000 | Spectrum plot will not display if the Time Trend Length is greater than 10,000; change the Time Trend Length to an appropriate value or enable Decimation |
| E902 | Cannot display the Spectrum plot | Spectrum plot will not display if Time Trend plot is disabled |

# Appendix D: Example Program to Copy Large Files

This appendix contains an example of a GPIB program that you can be use to copy a data log file that is larger than 1.4 MB. A data log file larger than 1.4 MB exceeds the capacity of a floppy disk. This GPIB program allows you to transfer large data log files from the oscilloscope to a personal computer.

Refer to *Appendix B: GPIB Command Syntax* for a complete list of the GPIB command syntax with the arguments, variables, and variable values.

```
/* Example Program to show how to copy file through
 * GPIB Interface

 * This Program reads the file named by global variable "read_from"
 * and copies that to file on your PC named by global variable
"write_to".

 */

#ifdef __cplusplus
extern "C"{
#endif
#include <windows.h>
#include <stdio.h>
#include <stdlib.h>
#include "decl-32.h"
#ifdef __cplusplus
}
#endif

// parameters needed to access the device driver handler

#define BDINDEX                0     // Board Index
#define PRIMARY_ADDR_OF_DMM    1     // Primary address of device
#define NO_SECONDARY_ADDR      0     // Secondary address of device
#define TIMEOUT                T10s  // Timeout value = 10 seconds
#define EOTMODE                1     // Enable the END message
#define EOSMODE                0     // Disable the EOS mode

char ErrorMnemonic[21][5] = {"EDVR", "ECIC", "ENOL", "EADR", "EARG",
                             "ESAC", "EABO", "ENEB", "EDMA", "",
                             "EOIP", "ECAP", "EFSO", "", "EBUS",
                             "ESTB", "ESRQ", "", "", "", "ETAB"};

// Files: for reading and writing

char read_from[] = "hd0:/APP/TDSJITV2/TEMP/RESULTS.CSV";
char write_to[] = "c:\\temp\\sac.csv";
```

```
/*
 *  After each GPIB call, the application checks whether the call
 *  succeeded. If an NI-488.2 call fails, the GPIB driver sets the
 *  corresponding bit in the global status variable. If the call
 *  failed, this procedure prints an error message, takes
 *  the device offline and exits.
 */
void GPIBCleanup(int ud, char* ErrorMsg)
{
    printf("Error : %s\nibsta = 0x%x iberr = %d (%s)\n",
            ErrorMsg, ibsta, iberr, ErrorMnemonic[iberr]);
    if (ud != -1)
    {
       printf("Cleanup: Taking device offline\n");
        ibonl(ud, 0);
    }
    exit(0);
}



int main(){

   int Dev;
   int status;
   char write_buffer[100];
   char read_buffer[100];

   int sleepTime = 1000;

   FILE *fp = fopen(write_to,"w");

   Dev = ibdev (BDINDEX, PRIMARY_ADDR_OF_DMM, NO_SECONDARY_ADDR,
          TIMEOUT, EOTMODE, EOSMODE);

   if (ibsta & ERR){
      GPIBCleanup(Dev, "Unable to open device");
   } else {
      printf("My device id - %i\n", Dev);
   }

   printf("Copying the file. Wait for some time...\n");

   /* Set the File Name */
   sprintf(write_buffer, "%s%s%s", ":FILESYSTEM:READF \"",
read_from,"\"");
   status = ibwrt(Dev, write_buffer, strlen(write_buffer));

   if (ibsta & ERR){
      GPIBCleanup(Dev, "Unable to start the application");
     return 0;
    }

   /* Wait for Some Time after a readF */
   Sleep(sleepTime);
```

```
   do {
      /* read the answer */
      ibrd(Dev, read_buffer, 99);

      read_buffer[ibcntl] = '\0';

      fprintf(fp,"%s",read_buffer);

   } while (ibcntl !=0);

   printf("Done \nCleanup: Taking device offline\n");
   ibonl(Dev, 0);

   fclose(fp);

}
```

# Index

# Index

## Symbols



## Numbers



## A



## C



## D

## E



## F



## G



## H



## I



## L



## M

## N



## O



## P

## Q



## R



## S



## T



## U



## V



## W