



## MANUAL CHANGE INFORMATION

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DESCRIPTION

PG. 47

**Effective with the Firmware Versions EXP 2.1, DIG 2.0 & DSY 2.0**

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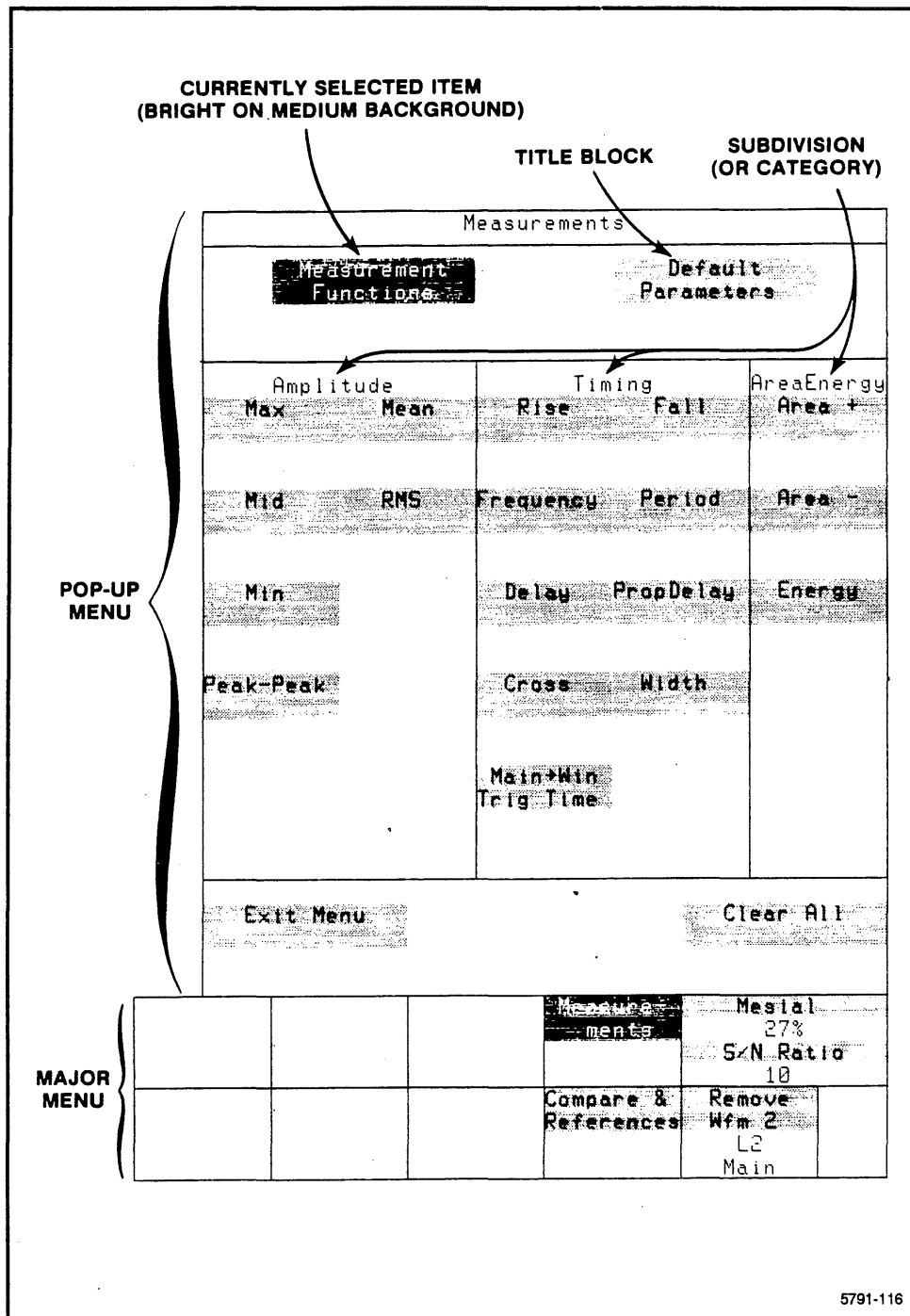


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Figure 2-5. Typical pop-up menu configuration.

## Icons and Labels

Functions that control the waveform display are accessed through icons and labels. Icons represent waveform display parameters and usually indicate their function with their shape and placement on the screen. For instance, the Vertical Size and Position icon is located beside the left vertical axis. The upper and lower graticules have identical icons.

The icon and label functions displayed for each last selected waveform graticule are:

### Icons—

- Trigger Level and Holdoff
- Vertical Size and Position
- Horizontal Size and Position

### Labels—

- **Cursor**—Cursors Position and Readout
- **Window1**—Waveform Window 1
- **Window2**—Waveform Window 2
- **DefWfm**—Define Waveform (displays a new trace)
- **RQS**—Request Service (for use with GPIB).

Icons and labels initially appear in medium intensity with a low intensity background. When selected, they change to high intensity on a medium intensity background. The selected icon or label will remain in this state until another selection is made. The system associates some selected icon functions (such as Horizontal Size and Position) with the knobs to the right of the screen, to allow their numeric parameters to be changed. While the knobs are assigned to a functional icon, a label will appear on the screen beside each knob to indicate the parameter it will adjust. For more information on the Top and Bottom Control knobs, refer to "Control Knobs and Numeric Keypad Operation" earlier in this section. The RQS label is discussed in section 3, "GPIB and RS-232-C Interfaces." Figure 2-3 shows the locations and shapes of all the icons and labels for a dual-graticule waveform display.

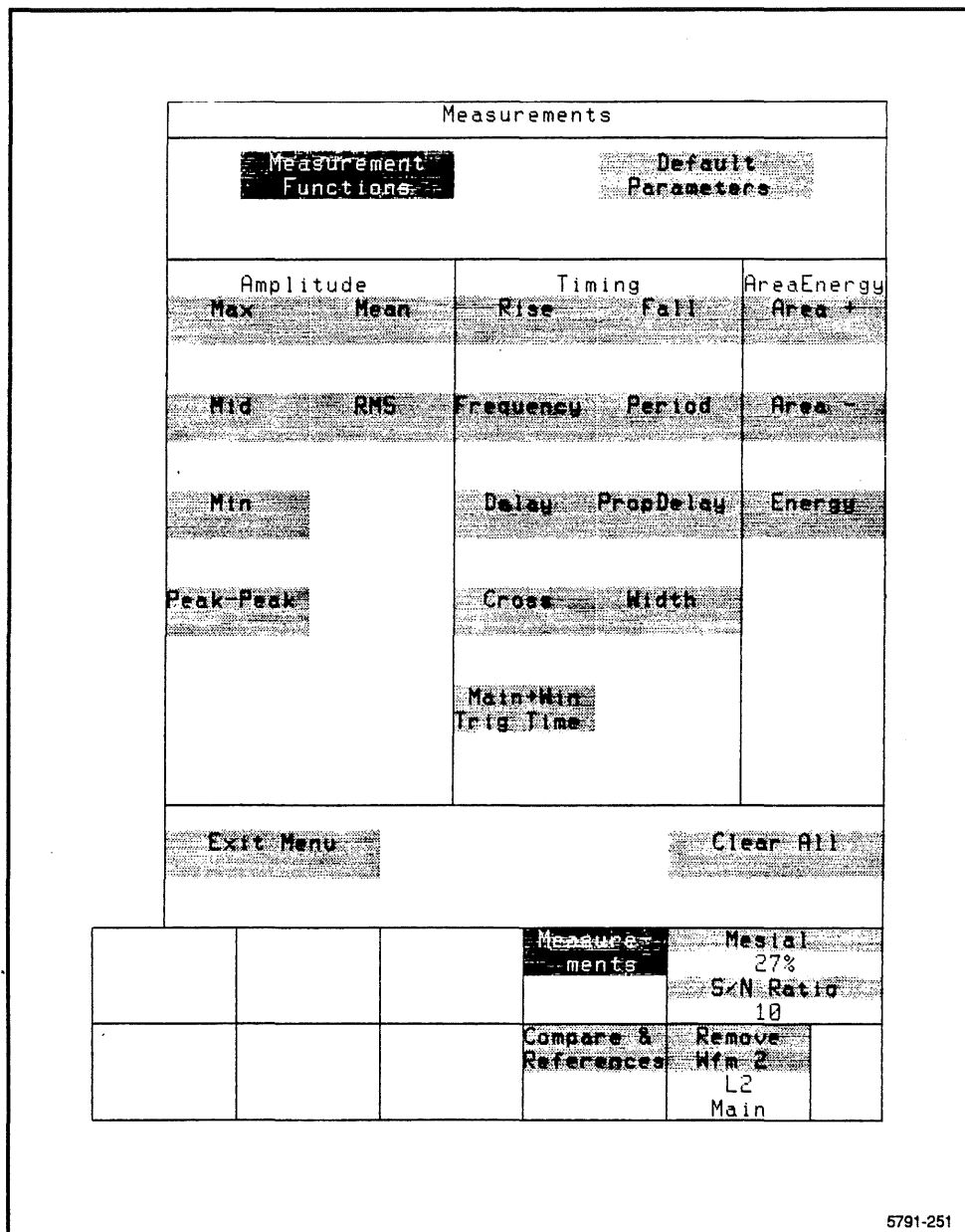
## Waveform Annotation

When the system invokes user-chosen measurements on the currently selected waveform, the various parameters that define the measurements can be shown on the waveform. For example, notation for the Rise Time measurement would show the lower and upper points (proximal and distal) on the waveform that were used to measure the rise time. Most default measurement parameters displayed can be changed to suit your needs. The measurement procedures are explained in detail in the Measuring Waveforms portion of this section.

## Measurements Pop-up Menu

When **Measurements** is selected, its label is highlighted in the menu/status area, and the **Measurements** pop-up menu is displayed in the waveform display area. Figure 2-28 shows the **Measurements** pop-up menu.

Two menu categories can be selected within the **Measurements** pop-up menu: one category displays **Measurement Functions** menu items (Figure 2-28); the other displays the **Default Parameters** menu items (Figure 2-29).



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Figure 2-28. Measurements pop-up menu with Measurement Functions selected.

## Measurement Functions Menu Category

The **Measurement Functions** category is divided into three classifications; **Amplitude**, **Timing**, and **Area/Energy**. Each individual measurement function (e.g., **Max**, **Min**, etc.) is discussed in detail under "Standard Measurement Functions", later in this section.

- **Amplitude**—Provides selections for measuring various waveform parameters dealing with amplitude.

**Max**—Provides readout of the maximum waveform value within the Measurement Zone.

**Min**—Provides readout of the minimum waveform value within the Measurement Zone.

**Mid**—Provides readout of the maximum waveform value plus the minimum waveform value divide by two within the Measurement Zone.

**Peak-to-Peak**—Provides readout of the maximum waveform value minus the minimum waveform value.

**Mean**—Provides readout of the mean waveform value over one cycle or the entire Measurement Zone.

**RMS**—Provides readout of the root mean square waveform value over one cycle or the entire Measurement Zone.

- **Timing**—Provides selections for measuring various waveform parameters dealing with the timing of a selected signal or signals.

**Rise**—Provides readout of the time duration between the Proximal and Distal points on the rising edge of a waveform.

**Fall**—Provides readout of the time duration between the Distal and Proximal points on the falling edge of a waveform.

**Width**—Provides readout of the time duration between the Mesial levels on successive edges of a waveform.

**Period**—Provides readout of the time duration between the Mesial level on one edge to the Mesial level on the next edge of the same slope.

**Frequency**—Provides readout of the inverse of the Period measurement.

**Delay**—Provides readout of the time duration between the first Mesial crossing and the last Mesial crossing on the selected waveform.

**Prop Delay**—Provides readout of the time between the first mesial crossing on the selected wfm and the first mesial crossing on a user specified delayed wfm.

**Main→Win Trig Time**—Provides readout of the time duration between the Main trigger point and the Window trigger point.



Measurements				
Measurement Functions			Default Parameters	
Left Limit		Right Limit		
0%		100%		
Tracking		Slope		
on		+		
Proximal	Distal	Reference Level		
10%	90%	0V		
Metal	S/N Ratio	Data Interval		
50%	10	one period		
Initialize Defaults			Copy Defaults to Sel. Wfm	
			Measurements	Main Size 50 $\mu$ s/div
				Main Pos -6 $\mu$ s
			Compare & References	Remove Wfm 1 L2 Main
				Pan/Zoom off

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Figure 2-29. Default Parameters category of the Measurements pop-up menu.

**Cross**—Provides readout of the time duration from the first record point to the point where the Reference Level is crossed.

- **Area/Energy**—Provides selections for measuring the energy content of a selected waveform or waveforms.

**Area +**—Provides readout of the total absolute value of all areas between a YT waveform and a user-specified Reference Level for one cycle or the entire Measurement Zone.

**Area –**—Provides a readout of the area bound by a YT waveform above a user specified Reference Level minus the area bound below the Reference Level for one cycle or the entire Measurement Zone.

**Energy**—Provides readout of the energy under a YT curve, relative to ground for one cycle or the entire Measurement Zone.

- **Exit Menu**—Executes the selections and exits the menu.
- **Clear All**—Removes all selected measurements from the menu/status area.

### XY Measurements

Detailed information on performing the following XY measurements is located near the end of the "Measuring Waveforms" subsection.

- **XY Area**—Provides the area result of an XY curve.
- **XY Energy**—Provides the energy result of an XY curve.

### Default Parameters Menu Category

Touching the **Default Parameters** label replaces the initial **Measurement Functions** menu category with the **Default Parameters** menu category items. (see Fig. 2-29). Parameter settings displayed in the **Default Parameters** category are the criteria for making measurements. Figure 2-30 illustrates where measure parameter annotations are located on the screen.

For detailed parameter definitions, refer to "Common Measurement Parameters" under "Standard Measurement Functions".

The following items are entries in the **Default Parameters** category:

- **Left Limit** and **Right Limit**—Defines the Measurement Zone limits. Waveform measurements are performed only within these limits.
- **Proximal**—Defines the lower measurement point for **Rise** time and **Fall** time measurements.
- **Mesial**—Defines the middle measurement point for Width, Period, Frequency, and Delay, and indirectly affects Mean, RMS, Area +, Area -, and Energy when Data Interval is set to One Period.
- **Distal**—Defines the upper measurement point for **Rise** time and **Fall** time measurements.
- **S/N Ratio**—Defines the signal-to-noise ratio (hysteresis) of the displayed signal to qualify Mesial crossings.
- **Reference Level**—Defines the dc reference level for **Cross**, **Area+**, and **Area-** measurements.

- **Tracking**—Controls whether the Topline and Baseline values track the changing waveform levels, or remain fixed.
- **Data Interval**—Sets the measured portion of a waveform to a **one** period or the **whole** Measurement Zone.
- **Slope**—Sets the slope polarity for the **Cross** Measurement.
- **Initialize All**—Sets the variable parameters in the **Default Parameter** category to the settings shown in Table 2-5.
- **Copy Defaults to Sel Wfm**—Sets measurement parameters for the selected waveform to the Default Parameter settings.

Most displayed parameters can be changed by touching the parameter label and rotating the appropriate Control knob. The three exceptions are **Data Interval**, **Tracking**, and **Slope** which toggle between their two states.

**TABLE 2-5**  
**Initialized Default Parameters Settings**

Parameter	Default at Initialize
Left Limit	First point on waveform display (0%).
Right Limit	Last point on waveform display (100%).
Topline	100% level automatically calculated from waveform data.
Distal	90% of Topline.
Mesial	50% of Topline.
Proximal	10% of Topline.
Baseline	0% level automatically calculated from waveform data.
S/N Ratio	10.
Data Interval	One period cycle.
Reference Voltage	0 volts.
Tracking	On.
Slope	+

### Tracking Measurement Mode

Timing, Area, and Energy measurements may operate in one of the two following modes:

1. **Tracking**—The waveform parameters (Topline and Baseline) and all active measurements track the changing waveform data.
2. **Nontracking**—The waveform parameters (Topline and Baseline) are user set and will not follow waveform data changes. This mode is useful when the user does not want these parameters automatically set. The parameters Proximal, Mesial, and Distal, which are based on Topline and Baseline, will not follow waveform variations.

### Waveform Annotation

Waveform annotation for the waveform parameters is displayed in the graticule area on the selected waveform. Waveform annotation for measurement functions consists of a combination of:

1. **Measurement zone indicators**—The Left Limit and Right Limit bracket the portion of the selected waveform to be used for measurements. Once set, these limits are used for all measurements of that waveform.
2. **Information-only measurement annotations**—Waveform parameters that have significant meaning to a measurement's algorithm, but which cannot be changed by the user (e.g., the intensified portion of a waveform measuring rise time).
3. **Adjustable measurement annotations**—Waveform parameters that have significant meaning to the algorithm, and are set by the Control knobs (e.g., Mesial or Reference voltage).

These waveform annotations are displayed on the screen relative to the waveform point or area. They appear in the form of intensified regions on the waveform, or as vertical or horizontal dashed lines. See Figure 2-30 for a typical waveform annotation.

Only one measurement's waveform annotation and parameter pop-up menu may be displayed at a time. Any measurement function (e.g., **Rise**, **Mean**, etc.) may be selected to show its particular waveform annotation. To observe a measurement's annotation or to change its parameters, select that measurement (touch the label) in the menu/status area.

Waveform annotation is displayed only when the Measure major menu is selected. That is, selection of a different major menu removes the annotation. Upon reentry to the Measure menu (when measurement functions have already been selected), the waveform annotation is restored to its previously set condition.

## Standard Measurement Functions

All standard measurement functions can be selected from the **Measurements** pop-up menu by touching the **Measurements** label in the Measure major menu. Selected measurements and their results appear in the menu/status area. Measurements are performed continuously on plug-in channel waveforms and only once on stored waveforms.

Most measurements produce six-digit results. **Cross** and **Main to Window Trigger Time** measurements are exceptions; they return eight-digit results.

For a discussion of data quality and waveform Averaging refer to "Data Used for Measurements" at the end of Oscilloscope System Architecture which immediately follows this manual's introductory statement.

The following text discusses the common measurement parameters used by the various measurement functions. Each measurement function in the **Measurements** pop-up menu is then described.

### Common Measurement Parameters Defined

The Standard Measurement parameters used in this instrument are described in detail here, and illustrated in Figure 2-30. Table 2-4 gives initialized default settings for the measurement parameters listed alphabetically below.

**Baseline**—The Baseline vertical value is the zero percent level to which Proximal, Mesial, and Distal are referenced. (Topline is the 100 percent level.) The Baseline vertical value is used to determine:

- Proximal and Distal values for measuring **Rise** and **Fall**.
- Mesial value used for measuring **Period**, **Frequency**, **Width**, **Mean**, **RMS**, **Delay**, **Area+**, **Area-**, **Energy**, and **Prop Delay**.

By default, Baseline is automatically determined by an algorithm. The algorithm finds the average vertical value then looks for a lower than average vertical value that occurs very frequently in a waveform record. If a low recurrent value is not found, then the minimum vertical value is used for the Baseline level. For example, the vertical value of the flat bottom of a square wave would meet the low recurrent value condition and become the Baseline level. A sawtooth waveform would default to the second condition and its minimum vertical value would become the Baseline level.

Normally, the **Tracking** function is on so Baseline is automatically set. When Tracking is set to off, Baseline can be selected from the measurement's pop-up menu and set with a Control knob to any value less than or equal to the Topline value. The Setup function will determine a Baseline value on a single scan when used with Tracking off.

Baseline is not selectable when **Tracking** is on. Further, Baseline is not selectable when the **Data Interval** is set to the entire zone in the Mean, RMS, AREA+, and Energy pop-up menus. Period, Freq, Delay, and Width still allow selection. When Baseline is selected, Topline and Baseline are assigned to the Control knobs. A unique dashed line displays the baseline level. See Figure 2-30.

**Data Interval**—Data Interval determines which Measurement Zone data will be measured. It can be toggled between a single period of the selected waveform and the entire Measurement Zone (see Figure 2-32). The period is from one Mesial crossing on the selected waveform to next Mesial crossing with the same slope. S/N Ratio levels must be crossed within the Measurement Zone. Data Interval is available on the **Mean**, **RMS**, **Area+**, **Area-**, and **Energy** measurements from their pop-up menus.

When Data Interval is set to the entire zone, parameters Topline, Mesial, Baseline, Signal/Noise Ratio, Tracking, and Setup are not selectable.

**Distal**—The Distal (most-distant) from the origin) vertical value determines one end of the timing region for **Rise** and **Fall** measurements (see Proximal). Distal is set to some percentage of the vertical range between Baseline (0%) and Topline (100%) vertical values. The initialized default level of Distal is 90%.

When selected from a measurement's pop-up menu, Distal assigns Proximal % and Distal % to the Control knobs. Distal can be up to 100% of the Topline value and will always be greater than or equal to Mesial and Proximal. Distal will be pushed up by Mesial and Proximal if they are increased above its level. A unique dashed line is displayed for a visual reference (see Figure 2-30), along with the Distal % and corresponding vertical value.

The current status of Distal is shown below the **Distal** label in the measurement's pop-up menu.

**Measurement Zone**—The Measurement Zone is the segment of the waveform (bracketed by the **Left** and **Right Limits**) where measurements are performed. All active measurements are taken within the selected waveform's Measurement Zone. Each displayed waveform has its own set of Measurement Zone limits which are displayed and used for measurements whenever the waveform is selected. The **Left** and **Right Limits** can be positioned to bracket a particular portion of a waveform for measurement. The limits are tied to the waveform record points, not the display points, for better resolution. In horizontal Pan/Zoom, the limits may be off screen, so measurements may not correspond to the displayed portion of the waveform.

Selecting the **Left** or **Right Limit** label from a measurement's pop-up menu assigns the Control knobs to the **Left Limit** and the **Right Limit**.

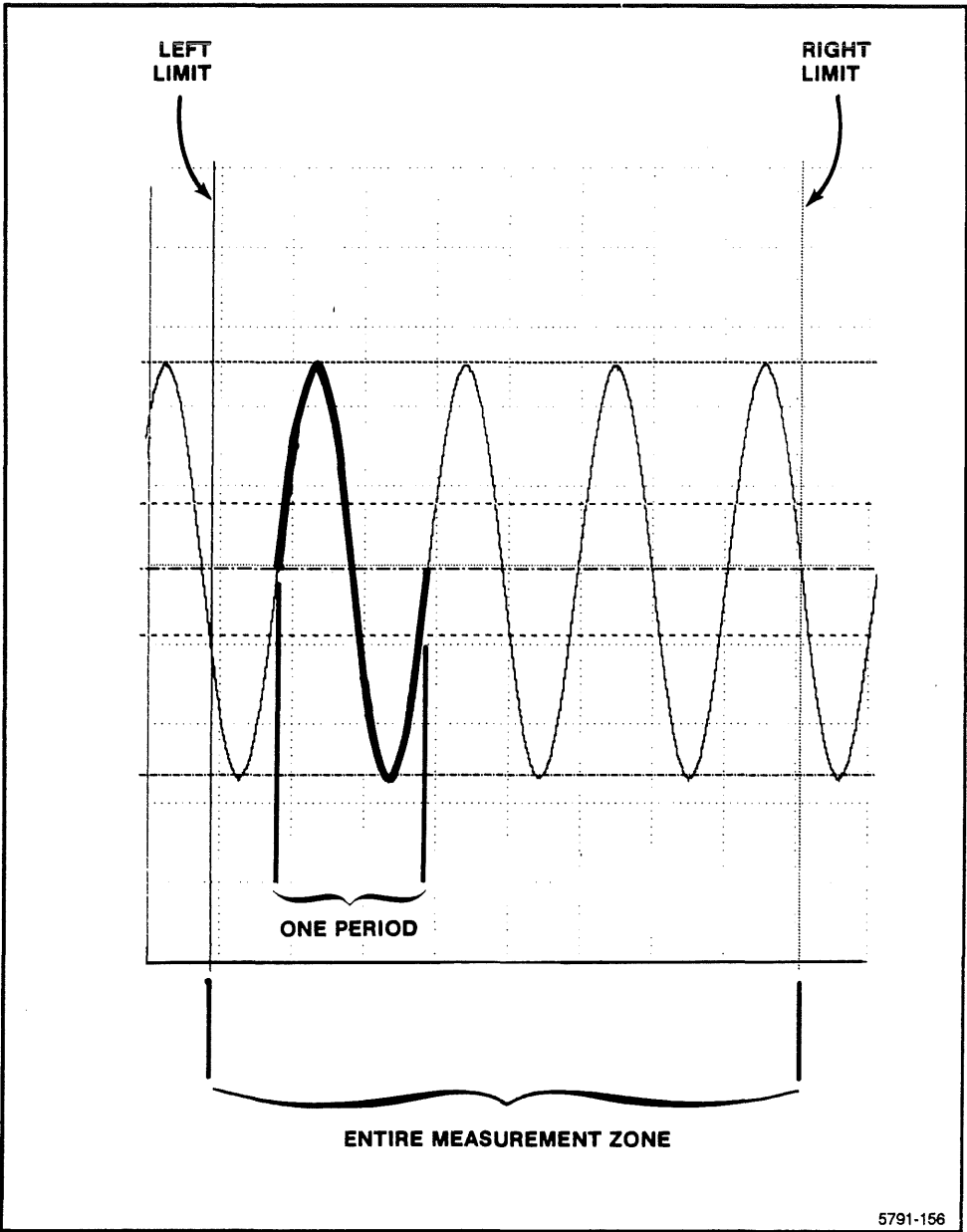


Figure 2-32. Data Interval Parameter.

The **Left** and **Right Limits** are displayed as vertical bars the full height of the graticule for YT waveforms and as intensified dots on XY waveforms. Initially, the **Left Limit** is at the extreme left (0%) and the **Right Limit** is at the extreme right (100%). See Figure 2-30. As the Measurement limits are moved, their position readout (Control knob labels) will show the percentage of travel from left to right. The position statuses of the **Left** and **Right Limits** are also shown below their labels in the **Measurement's** pop-up menu.

Measurements performed on a full period require the full period to be contained in the Measurement Zone. This implies that the Mesial and Signal/Noise Level crossings must occur within the Measurement Zone.

**Mesial**—The Mesial (middle) vertical value determines the end points of the waveform period used for **Mean, RMS, Period, Frequency, Width, Delay, Prop Delay, Area+, Area-,** and **Energy** measurements. Mesial is set to some percentage of the vertical range between Baseline (0%) and Topline (100%) values. The initialized default level of Mesial is 50%.

When selected from a measurement's pop-up menu, Mesial % and Signal/Noise Ratio are assigned to the Control knobs. Mesial must be less than or equal to Distal and greater than or equal to Proximal. If Mesial is increased to 100% it will push Distal to 100%. Likewise, Mesial may be decreased to 0% pushing Proximal to 0%. A unique dashed line is displayed (see Figure 2-30) with the Mesial % and corresponding vertical value. The current Mesial status is shown below the **Mesial** label in the measurement's pop-up menu.

**Proximal**—The Proximal (closest to the origin) vertical value determines one end of the timing region for **Rise** and **Fall** (see Distal). Proximal is set to some percentage of the Vertical range between Baseline (0%) and Topline (100%) values. The initialized default value of Proximal is 10%.

When selected from a measurement's pop-up menu, Proximal % and Distal % are assigned to the Control knobs. Proximal can be set to any percentage down to the Baseline which is 0%. The percentage of Proximal must always be less than or equal to Mesial. As Proximal is increased it may encounter Mesial at which time they will both increase to stay equal. A unique dashed line is displayed (see Figure 2-30), with the Proximal % and corresponding vertical value. The current Proximal status is shown below the **Proximal** label in the measurement's pop-up menu.

**Reference Level**—The Reference Level is a vertical value that provides one boundary for the Area and Cross measurements. The other vertical boundary is the selected waveform. The initialized default value of Reference Level is zero volts. A unique dashed line displays the Reference Level.

When selected from a measurement's pop-up menu, Reference Level is assigned to the Control knobs. Reference Level is normally adjusted with a resolution of one division per click of the knob. Fine resolution is available by touching the Control knob label, then selecting Fine from the Numeric Entry and Knob Res pop-up menu. The vertical value is displayed below the **Reference Level** label in the measurement's pop-up menu.



**Setup**—The Setup function does a single Tracking scan of the waveform to determine a Topline value and a Baseline value (see Tracking). Setup is selectable only from a measurement's pop-up menu when Tracking is available and turned off. Once Setup has determined the Topline and Baseline values, they may be manually adjusted with the Control knobs.

**S/N Ratio (Signal/Noise)**—The Signal-Noise Ratio is a user set value that helps define the Mesial crossings used for the end points of measurements (e.g., **Period** and **Width**). The ratio value is converted to a voltage region whose size is based on the peak-to-peak value of the waveform segment being measured (within the Measurement Zone). The S/N Ratio region is split evenly above and below the Mesial level. The upper and lower limits of the S/N Ratio region are marked with unique dotted lines. See Figure 2-33. For a 10 volt peak-to-peak signal with a S/N Ratio of 20 the S/N Ratio region will be 1/2 volt. This region value is split so that S/N Ratio lines are displayed 1/4 volt above and 1/4 volt below the Mesial line.

S/N Ratio can be set to any positive value from 1 to 99. Lower values produce larger S/N Ratio regions and better immunity to noise. The initialized default value of S/N Ratio is 10. Selecting the **S/N Ratio** label from a measurement's pop-up menu assigns S/N Ratio and Mesial % to the Control knobs. The current setting of S/N Ratio is shown under its pop-up menu label and under its Control knob label. Fine control of S/N Ratio is available by touching its Control knob label and selecting Fine. The Numeric Keypad may also be used to enter a value.

S/N Ratio and Mesial can be used together to define the period or pulse to be measured within the Measurement Zone. Noisy signals can be reliably measured by setting the S/N Ratio so the peak noise level will not qualify Mesial crossings. See Figure 2-33 for an example of using the S/N Ratio to define the Period on a noisy waveform. For oddly shaped, repetitive waveforms Mesial can be positioned and S/N Ratio adjusted so that only the desired period or pulse is measured.

**Topline**—The Topline vertical value is the 100% level to which Proximal, Mesial and Distal are referenced. (Baseline is the Zero percent level.) The Topline vertical value is used to determine:

- Proximal and Distal values for measuring **Rise** and **Fall** times.
- Mesial value used in measuring **Width**, **Frequency**, **Mean**, **RMS**, **Delay**, **Area+**, **Area-**, **Energy**, and **Prop Delay**.

By default, Topline is automatically determined by an algorithm. The algorithm finds the average vertical value, then looks for an above average vertical value that occurs very frequently in the waveform record. If a high recurrent value is not found, then the maximum vertical value is used for the Topline level. For example, the vertical value of the flat top of a square wave would meet the high recurrent value condition and become the Topline level. A sawtooth waveform would default to the second condition and its maximum vertical value would become the Topline level.

Normally, the Tracking function is on so Topline is automatically set. When Tracking is set to off, Topline can be selected from the measurement's pop-up menu and set with a Control knob to any value greater than or equal to the Baseline value. The Setup function will determine a Topline value on a single scan when used with Tracking off. Topline can then be adjusted manually.

Topline is not selectable when Tracking is on or when Data Interval is set to the entire zone. When selected, the Topline and Baseline adjustments are assigned to the Control knobs. A unique dashed line displays the Topline level. See Figure 2-30.

**Tracking**—Tracking toggles **on** and **off**. When on, Tracking automatically extracts the Topline and Baseline values from the Measurement Zone data. Topline and Baseline are not selectable when Tracking is on. When turned off, the values for Topline and Baseline do not follow waveform changes but may be set by the user. If no user-defined values for Topline and Baseline are entered, the present values are used. The measurement parameters Proximal, Mesial, and Distal are referenced to Topline and Baseline values. With Tracking off, these measurement parameters will be referenced to user-set values for Topline and Baseline.

**Waveform  
Annotation**

Selecting the **Delay** label in the menu/status area causes the following annotation to appear on the waveform:

1. Two vertical bars define the Measurement Zone. The **Left** and **Right Limit** bars can be moved with the Control knobs when selected from the pop-up menu.
2. The Topline level of the Measurement Zone is displayed as a unique dashed line across the top of the waveform. Normally, Tracking is on so Topline is set automatically. Topline can be set with a Control knob by setting Tracking off in the pop-up menu and selecting Topline.
3. The Mesial percentage of the Measurement Zone is displayed as a unique dashed line across the middle of the waveform. It is variable with the Control knobs when selected from the pop-up menu.
4. The Baseline level of the Measurement Zone is displayed as a unique dashed line across the bottom of the waveform. Normally, Tracking is on so Baseline is automatically set. Baseline can be set with a Control knob by setting Tracking off in the pop-up menu and selecting Baseline.
5. The Signal-to-Noise Ratio value is displayed as a pair of unique dashed lines that are positioned equidistant from the Mesial line. S/N Ratio can be set with a Control knob by selecting it from the pop-up menu.
6. The measured segment on the selected waveform is shown at high intensity. Window indicators on the selected waveform are not displayed when the period is intensified.

## Propagation Delay

*Press the MEASURE MENUS button to display the Measure major menu at the bottom of the screen. Then touch the **Measurements** label to display the **Measurements** pop-up menu. Select the **Prop Delay** label from the pop-up menu to invoke the measurement. The **Prop Delay** label with its value will be displayed at the bottom of the screen. Refer to "Selecting and Ending Measurements" for further information.*

Propagation Delay measures the absolute time between a mesial waveform crossing on the currently selected waveform and a mesial waveform crossing on any other specified delayed waveform, within the Measurement Zone. The delay-time value between the first and last mesial crossings is displayed below the **Delay** label in the menu/status area. Figure 2-56 shows a typical Delay measurement example.

The Prop Delay measurement is normally performed using the Default Parameter settings for the parameters shown in Figure 2-57a. These measurement parameters are used by other active measurements and can be changed with:

- The **Prop Delay** pop-up menu,
- the pop-up menu of another active measurement that uses the same parameters, and
- the Default Parameters category of the **Measurements** pop-up menu. Refer to "Default Parameters Menu Category" under "Measurements Pop-up Menu" for detailed information.

This measurement can be performed only on YT waveforms. The status is displayed as undefined for XY waveforms.

The **Compare & References** function (in the menu/status area) alters the status of the **Prop Delay** function, and adds a delta symbol to the name of the function (i.e.,  $\Delta$ Prop Delay).

Algorithms for all standard measurement functions are defined in Appendix B.

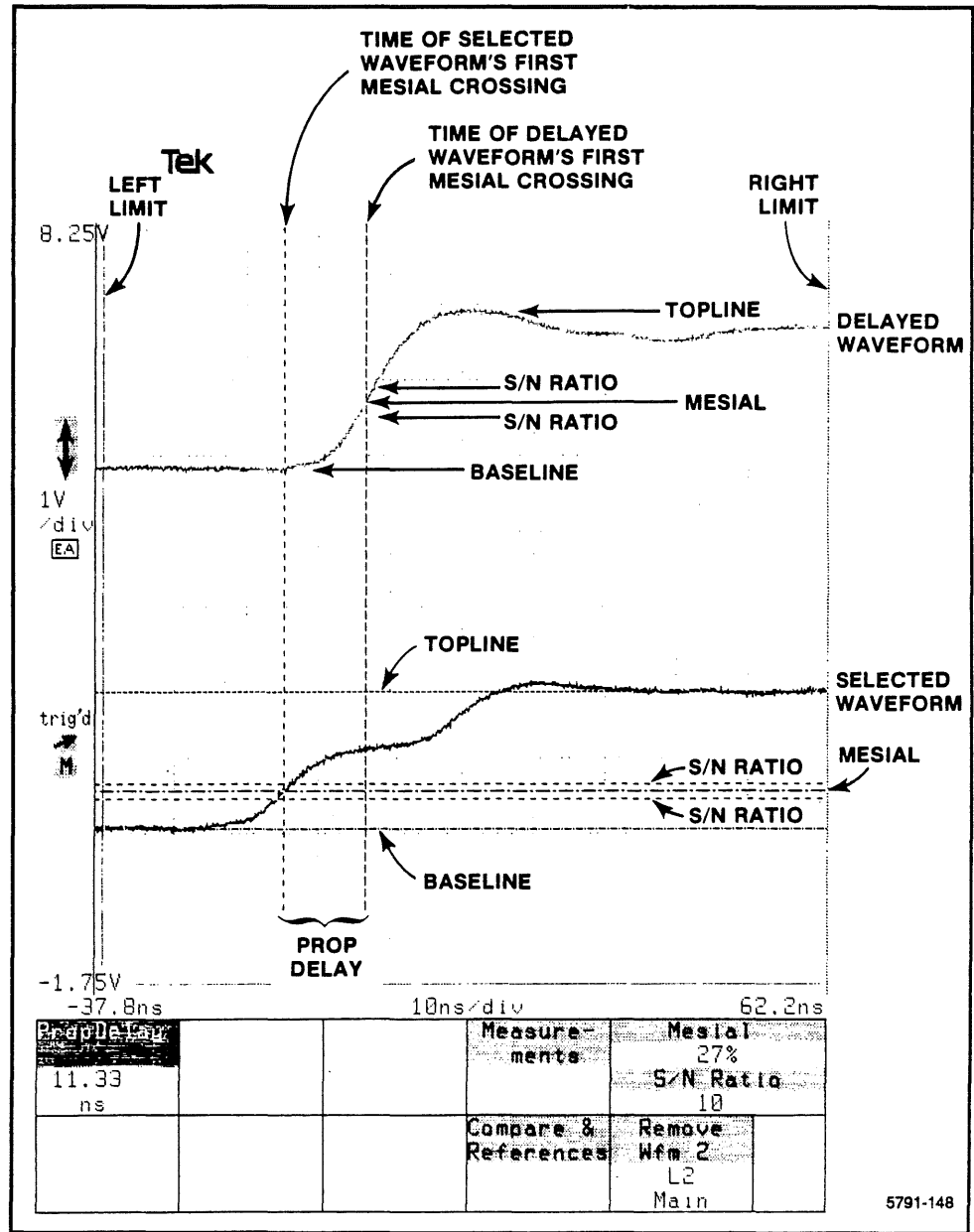


Figure 2-57a. Propagation Delay measurement example.

### Prop Delay Pop-up Menu

Selecting the **Prop Delay** label causes the **Prop Delay** pop-up menu to appear in the waveform display area and highlights its label in the menu/status area. The **Prop Delay** pop-up menu is shown in Figure 2-57b.

The items in the pop-up menu allow control of the measurement's parameters, when selected. Current settings are displayed below the item labels. Unless previously modified for this or another active measurement, the current settings of the measurement parameters will be equal to the Default Parameter values.

Menu Items

The selected waveform and the specified delayed waveform both have the following measurement parameters as entries in the **Prop Delay** pop-up menu:

1. **Left and Right Limit**
2. **Baseline**
3. **Topline**
4. **Mesial**
5. **S/N Ratio (Signal/Noise)**
6. **Tracking**
7. **Setup**

For a detailed discussion of these measurement parameters, see "Common Measurement Parameters" under "Standard Measurement Functions".

PropDelay				
Wfm 1		Wfm 2		
L1		L2		
Main		Main		
Selected Waveform		Delayed Waveform		
<b>Left Limit</b>	<b>Right Limit</b>	<b>Left Limit</b>	<b>Right Limit</b>	
0%	100%	0%	100%	
-39.0000ns	63.3000ns	-39.0000ns	63.3000ns	
Baseline	Topline	Baseline	Topline	
0%	100%	0%	100%	
330.0mV	2.130V	340.0mV	2.120V	
<b>Mesial</b>	<b>S/N Ratio</b>	<b>Mesial</b>	<b>S/N Ratio</b>	
27%	10	50%	10	
816.0mV		1.230V		
<b>Tracking</b>	<b>Setup</b>	<b>Tracking</b>	<b>Setup</b>	
on		on		
<b>PropDelay</b>			<b>Measurements</b>	<b>Mesial</b>
11.22				27%
ns				<b>S/N Ratio</b>
				10
			<b>Compare &amp; References</b>	<b>Remove</b>
				Wfm 2
				L2
				Main

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Figure 2-57b. Prop Delay pop-up menu.

**Waveform  
Annotation**

Selecting the **Prop Delay** label in the menu/status area causes the following annotation to appear on the display screen:

1. Two vertical bars define the Measurement Zone<sup>1</sup>. The **Left** and **Right Limit** bars can be moved with the Control knobs when selected from the pop-up menu.
2. The Topline level of the Measurement Zone is displayed as a unique dashed line across the top of the waveform<sup>1</sup>. Normally, Tracking is on so Topline is set automatically. Topline can be set with a Control knob by setting Tracking off in the pop-up menu and selecting Topline.
3. The Mesial percentage of the Measurement Zone is displayed as a unique dashed line across the middle of the waveform<sup>1</sup>. It is variable with the Control knobs when selected from the pop-up menu.
4. The Baseline level of the Measurement Zone is displayed as a unique dashed line across the bottom of the waveform<sup>1</sup>. Normally, Tracking is on so Baseline is automatically set. Baseline can be set with a Control knob by setting Tracking off in the pop-up menu and selecting Baseline.
5. The Signal-to-Noise Ratio value is displayed as a pair of unique dashed lines that are positioned equidistant from the Mesial line<sup>1</sup>. S/N Ratio can be set with a Control knob by selecting it from the pop-up menu.
6. Two vertical timing bars denote mesial crossings on the selected waveform and on the delayed waveform.

<sup>1</sup> Used to annotate the selected waveform or the delayed waveform but not both at once.





(A)

Probes					
Probe ID Function					
Waveform Select		Wfm Select/ New		Sequence Settings	
/ New Wfm		Wfm & AutoSet			
Calibrate, Deskew, and Compensate Probes					
L1		C		R	
L2					
<p>To Cal, Deskew, and Compensate:</p> <p>Connect probe or input to the calibrator;</p> <p>Then select channel from this menu.</p>					

GPiB Parameters	RS232C Parameters	Probes	Self Test	Main Size	Main Pos
TalkListen 1	9600Bd			50µs/div	-6µs
Initialize	Time & Date	Instr Options	Extended Diagnostic	Remove Waveform	
	14:02:36 9-OCT-87				

(B)

Probe Compensation					
Select		Exit			
Next Chan		Comp			

GPiB Parameters	RS232C Parameters	Probes	Self Test	Main Size	Main Pos
TalkListen 1	9600Bd			200µs/div	-23.9765396µs
Initialize	Time & Date	Instr Options	Extended Diagnostic	Remove Wfm 1	Panel Zoom
	16:41:31 1-OCT-87			L1 Main	off

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Figure 2-82. Probes and Probe Compensation menus.

- **Calibrate, Deskew and Compensate Probes**

All presently installed plug-in channels are listed so that each may be deskewed, calibrated, and compensated. A simplified procedure, to calibrate, deskew, and compensate probes is displayed on the screen. A more detailed procedure is given here:

1. Standard Amplifier Plug-In Units

**NOTE**

*The following procedure is valid only for standard amplifier plug-in units. Refer to the next procedure for calibrating differential amplifier plug-in units.*

- a. Connect the probe or other input lead to the front-panel CALIBRATOR's signal and ground connections.
- b. Touch the **Probes** pop-up menu label that describes the channel (e.g., R1 for Right, channel 1). The channel will be vertically calibrated, then deskewed (balances the propagation delay) against an internal reference signal. The deskew operation aligns waveform records to negate differences greater than 10 ps in the propagation delays through different channels. Inductance and resistance of the probes and channels as seen by the incoming signal are not changed. Calibration and deskewing are complete when a message appears at the top of the screen that prompts you to compensate the probe.
- c. When the **Probe Compensation** pop-up menu is displayed (refer to Fig. 2-82B), compensate the probe by adjusting the compensation control on the probe. Adjust the control so the displayed square wave has a flat top.
- d. If another channel is to be calibrated, touch the **Select Next Chan** label to return to the **Probes** pop-up menu. Otherwise touch the **Exit Comp** label to finish compensation.

2. Differential Amplifier Plug-In Units.

This calibration procedure will improve common mode rejection when using probes recommended for a differential amplifier or differential comparator plug-in (e.g., P6135, P6134).

The two probes used must be of the same type.

- a. Install one probe on the  $-$ input of the differential amplifier plug-in. (There must be no probe installed on the  $+$ input.)
- b. Perform step a, b, and c in the procedure described above. On a P6135 probe, both LF COARSE and LF FINE may be used.

- c. Install the other probe on the +input of the differential amplifier plug-in. Connect this probe to the front-panel CALIBRATOR's signal and ground connections. Do not remove the other probe from the CALIBRATOR.
- d. Observe that the waveform displayed on screen has become nearly a straight line. There may be a small spike where the step was displayed, and the trace segments before and after this horizontal point may be displaced vertically from one another.
- e. Compensate the probe connected to the +input. On a P6135 probe, adjust the DC ATTEN and LF FINE (and the LF COARSE if necessary) to reduce the display to a straight line, eliminating the spike and the vertical displacement. On a P6134 probe, adjust only the compensation adjustment to eliminate the spike. The vertical displacement (dc attenuation mismatch) cannot be removed.
- f. To end the procedure, touch the **Exit Comp** label in the Probe Compensation menu, and disconnect the probes from the CALIBRATOR.

## Instrument Configuration and Display Options

Selecting the **Instr Options** label in the Utility major menu allows selection of a variety of operating modes and provides a complete listing of the current system configuration. The display intensity and display mode can also be changed in the **Instrument Options** pop-up menu. Initializing the instrument will set the instrument options to their default settings. See "Initialize Function" later in this section for a listing of Initializing defaults.

The instrument configuration information listed at the bottom of the **Instrument Options** pop-up menu is useful when ordering accessories and plug-in units, and for instrument service personnel.

### Instrument Options Pop-up Menu

Touching the **Instr Options** label in the Utility major menu causes its pop-up menu to be displayed in the waveform display area (see Fig. 2-83). Current status information is displayed below the pop-up menu labels.

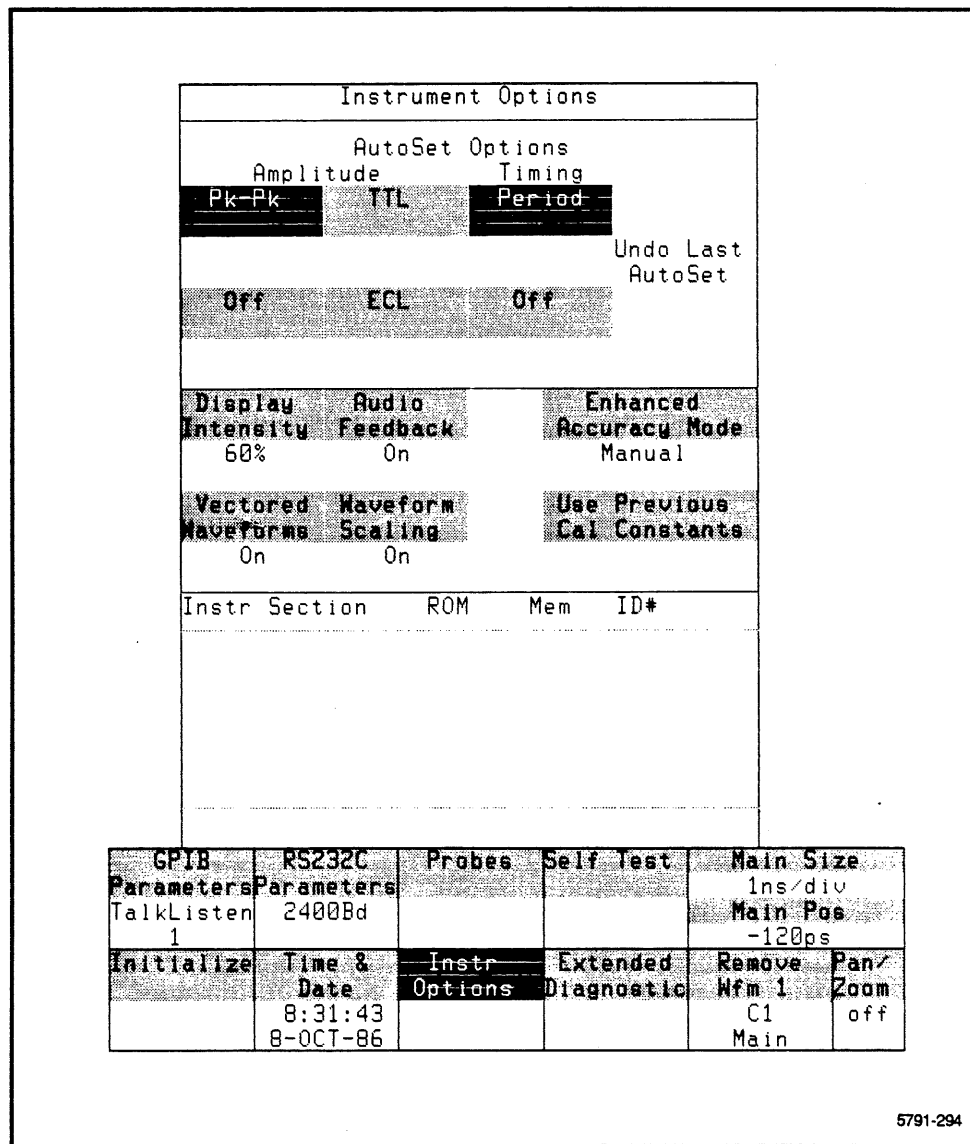
#### Menu Items

The following categories and items are entries in the **Instrument Options** pop-up menu:

- Configuration information—A listing of mainframe and plug-in identity information. The version numbers of the Tektronix GPIB Codes and Formats Standard and the instrument options installed in this particular instrument are displayed below the Configuration Information. This list includes:

**Instr**—The names of the mainframe and installed plug-in units.

**Section**—The major section of the named instruments in column one.



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Figure 2-83. Instrument Options pop-up menu.

**ROM**—The version of firmware in each section of the named instruments.

**Mem**—The amount of memory in each section of the named instruments if memory options exist.

**ID#**—The identification number for each section of the named instruments.

- **AutoSet Options**—For more information refer to "Displaying a Waveform Using AUTOSET" in this section.

**Timing**—The automatic **Timing** (time base control) feature may be turned **Off** or left in the **Period** mode.

**Amplitude**—The automatic **Amplitude** (vertical sensitivity) feature may be turned **Off** or put in one of three modes: **Pk-Pk**, **TTL** or **ECL**. The **TTL** and **ECL** choices set the vertical scale for the logic levels of their respective IC families. The default **Pk-Pk** selection seeks a vertical scale based on an automatic peak-to-peak measurement of the acquired signal.

**Undo Last AutoSet**—Returns all settings to the state that existed prior to pushing the front-panel **AUTOSET** button.

- **Display Intensity**—Assigns a Control knob to adjust the intensity of the display screen.
- **Audio Feedback**—Toggles the audible feedback associated with the instrument controls and error messages **On** or **Off**.
- **Enhanced Accuracy Mode**—Toggles the Enhanced Accuracy self calibration system between **Manual** and **Automatic** execution. In the automatic mode, the instrument automatically recalibrates itself to the Enhanced Accuracy state when the internal temperature changes  $\pm 5^{\circ}\text{C}$ .
- **Vectorized Waveforms**—Toggles the vectoring of waveform displays **On** or **Off**. When **Off**, adjacent waveform data points are not connected by vectors on the display.
- **Use Previous Cal Constants**—all previously calibrated plug-in channels are set to their last established settings. This is useful after power-up.
- **Waveform Scaling**—Toggles between Forced and Optional. When set to Forced, all subsequently defined Waveform functions are computed using floating point, high precision arithmetic. Resolution is increased to six digits for all Waveform functions, but Average and Envelope, which give adequate results using four-digit integer arithmetic, will take longer to compute.

When toggled to Optional, subsequently defined Waveform Functions that only need integer arithmetic and four digit resolution will be computed more quickly using integer arithmetic. Functions that require floating point arithmetic (e.g., Log, Diff, etc.) will still be computed using floating point arithmetic.

Waveforms defined before the status of Waveform Scaling was changed are not affected by the change. They continue to be computed with the mode that was in effect when they were created.

## Self Test

Selecting the **Self Test** label in the Utilities major menu initiates a set of internal diagnostic tests that do not require user intervention. The instrument stores settings as in a power-down sequence and proceeds with the tests. After an error-free run of the tests, the previous settings are restored and the instrument resumes normal operations. If an error is discovered, the instrument runs the remaining Self Tests, then automatically enters the **Extended Diagnostics** mode and displays the detected error(s). To set the display for normal operation, select the **(E)Exit** label at the bottom of the screen. If a fatal error is detected in the Digitizer or Display subsystems, exiting will not be possible.

The set of Self Tests can also be run when **Extended Diagnostics** are invoked. Some of the **Extended Diagnostics** tests require action by the service person, whereas no Self Tests require or allow user interaction. Touching the Touch Screen or any front panel buttons during the Self Test may result in a test error condition. Refer repair of this instrument to qualified Service personnel.

## Extended Diagnostics

Touching the **Extended Diagnostic** label in the Utility major menu causes the instrument to enter the Extended Diagnostics test mode. This mode provides qualified service personnel with diagnostic tools to help troubleshoot the instrument. If Extended Diagnostics is inadvertently selected, the **Extended Diagnostics** menu will appear in the menu/status area. Normal operation mode can be resumed by touching the **(E)Exit** label in the lower right corner of the screen.

The Extended Diagnostics mode is automatically entered if the instrument Self Tests fail. If a failure occurs, contact a qualified service person.

## Time and Date Control

Selecting the **Time and Date** label in the Utilities major menu allows the user to set the time and date and to view their current status. In addition, the number of hours of instrument on-time and the number of power-up operations are displayed.

The time and date function is provided by the hardware. (Battery backup provides nonvolatility.) Once the time and date has been set, the correct time/date will be kept to within seven minutes per year.

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## An Easy Way To Learn The Command Set

As you will see, the 11401/11402's command set is very large. Attempting to gain familiarity with the entire command set from small BASIC programs written on an RS-232-C or GPIB controller is sometimes tedious and subject to programming errors.

There is a simpler way to learn the command set. Instead of using BASIC on the RS-232-C or GPIB controller, connect an ASCII terminal to the 11401/11402's RS-232-C port. Once connected and properly configured, enable RS-232 ECHO and turn on the RS-232 VERBOSE mode (type "e" and a carriage return, then type "v" and a carriage return).

Now, simply experiment with the command set by typing "set" and "query" commands at the terminal's keyboard. In this way, you can try any command sequence imaginable (binary block formatted data transfers excluded) and immediately find out how the instrument reacts, and what type of errors and warnings it can report.

### NOTE

*For many commands and their links, detailed definitions and descriptions of corresponding front-panel functions can be found, previously, in the front-panel operation section of this manual.*

Once you feel comfortable with the command set and the 11401/11402's operation, you're ready to write useful programs on an actual controller.

## Channel Commands

Channel commands set and query the parameters of an 11000-Series vertical channel plug-in unit.

Header	Link	Argument	Notes
CH<slot><ui>	AMPOFFSET:	<NRx>	1
	BW:	<NRx>	2
	BWHI:	<NRx>	3
	BWLO:	<NRx>	3
	COUPLING:	AC DC OFF	4
	IMPEDANCE:	<NRx>	
	MNSCOUPLING:	AC DC VC OFF	1
	MNSOFFSET:	<NRx>	1
	MNSPROBE:	<qstring>	1,5
	OFFSET:	<NRx>	
	PLSCOUPLING:	AC DC VC OFF	1
	PLSOFFSET:	<NRx>	1
	PLSPROBE:	<qstring>	1,5
	PROBE:	<qstring>	4,5
	PROTECT:	ON OFF	1
	SENSITIVITY:	<NRx>	
UNITS:	<qstring>	5	
VCOFFSET:	<NRx>	1	
CH<slot>			6
CH			6

### Note

1. Link applies only to differential amplifier
2. Link applies only to amplifiers that have no high/low bandwidth function
3. Link applies only to amplifiers that have high/low bandwidth function
4. Link applies only to nondifferential amplifier
5. Query-only link
6. Query-only

## CH<slot><ui> Command

The <slot> component of this command header selects a particular plug-in compartment, and the <ui> header component selects a particular plug-in channel. Thus, to set or query any parameter of the third channel of the LEFT vertical plug-in amplifier the command header must appear as "CHL3."

Details of how these Channel command parameters operate is covered in the "Operating Information" section, and/or in the appropriate plug-in unit supplement.

## How Channel Command Parameters Apply

Not all CH<slot><ui> command parameters apply to all 11000-series plug-in units. Hence, parameters fall into four categories:

1. Parameters Common To All 11000-series Plug-in Units.
2. Nondifferential Plug-in Unit Parameters.
3. Differential Plug-in Unit Parameters.
4. Bandwidth Parameters

The following Channel command parameter listing is organized into the aforementioned categories.

### Parameters:

### NOTE

*The ranges and valid values for vertical parameters that take numeric arguments are unique to each type of plug-in unit. Therefore, see the appropriate plug-in unit supplement for setting ranges and valid setting values.*

### Category 1

**IMPEDANCE**—sets the channel input impedance, in ohms, to a value indicated by the argument.

**SENSITIVITY**—sets the specified channel's vertical input sensitivity (gain) to a value indicated by the argument.

**UNITS**—is a query-only link that returns a quoted string indicating the units of the selected channel.

### Category 2

**COUPLING**—sets the selected channel input coupling to one specified by the argument list.

**OFFSET**—sets the voltage subtracted from the input signal of the specified channel. OFFSET vertically positions a plug-in unit signal on the 11401/11402 display.

**PROBE**—is a query-only link that returns a quoted string indicating what type of probe is currently being used. For example, when a Level 1 TEKPROBE™ is connected, the 11401/11402 returns the quoted string, "Level 1". When a Level 2 TEKPROBE™ is connected, the 11401/11402 returns "Level 2/<probe\_type>/<serial\_number>". When neither a level two nor level one probe is connected, the query response is "NONE".

### Category 3

**AMPOFFSET**—sets the voltage subtracted from the input signal of the specified channel after the plus and minus differential input signals have been subtracted from each other. AMPOFFSET vertically positions a plug-in unit signal on the 11401/11402's display and is functionally equivalent to the OFFSET link of a nondifferential plug-in unit.

**MNSCOUPLING**—sets the selected channel's minus differential input coupling as indicated by the argument. When this function is set to OFF or VC, the specified minus input is internally disconnected from its external signal source.

**MNSOFFSET**—sets the probe offset voltage subtracted from the minus input of the specified channel. If the user attempts to set this function without having an offset-type probe connected, a warning will be reported and the offset value saved until an appropriate probe is connected.

**MNSPROBE**—this query-only link returns a quoted string indicating what type of probe is currently connected to the minus input of the specified channel. The possible responses are identical to those described for the PROBE link.

**PLSCOUPLING**—sets the selected channel plus differential input coupling as indicated by the argument.

**PLSOFFSET**—sets the plus input probe offset voltage of the specified channel.

**PLSPROBE**—this query-only link returns a quoted string indicating what type of probe is currently connected to the plus input of the specified channel.

**PROTECT**—sets the SENSITIVITY range of a differential amplifier. When PROTECT is ON, the minimum SENSITIVITY settings are restricted to protect front end hardware circuitry. When PROTECT is OFF, the SENSITIVITY range is not restricted.

**VCOFFSET**—sets an internal comparison voltage that serves as a plus or minus input signal when either PLSCOUPLING or MNSCOUPLING, respectively, is set to VC. Otherwise, there is no effect.

**OFFSET**—this link is independent of the nondifferential plug-in unit OFFSET. Differential OFFSET's argument modifies one of the other four differential offset functions (i.e., AMPOFFSET, MNSOFFSET, PLSOFFSET, and VCOFFSET). Just which function is affected depends upon the current input coupling and the type of probes connected to the inputs. See the applicable differential plug-in supplement for further details.

#### Category 4

**BW**—sets a plug-in's channel bandwidth to the value specified in the argument. This command link is valid only for plug-in units that do not have the BWHI/BWLO function.

**BWHI**—sets the specified channel upper bandwidth limit to a value specified by the argument. This is valid only for plug-in units that have the BWHI/BWLO feature.

**BWLO**—sets the specified channel lower bandwidth limit to a value specified by the argument. This is valid only for plug-in units that have the BWHI/BWLO feature.

## Level 2 TEKPROBES Versus Plug-In Unit Parameters

Attaching a Level 2 TEKPROBE™ to an input channel may cause a plug-in unit to reject coupling or impedance settings that are normally valid for that channel. Consult the appropriate plug-in unit supplement in this manual to determine which coupling and impedance settings are valid.

## Special Plug-in Unit Out of Range Considerations

The 11401/11402 normally returns out of range warnings for numerical values that exceed the valid range of a particular instrument setting. These values are not rejected, but are, instead, coerced to appropriate maximum or minimum settings.

Plug-in units, however, do not return warnings for out of range BW, BWHI, BWLO, or IMPEDANCE values. But, they do coerce out of range values to appropriate maximum or minimum settings.

## Special 11A33 Plug-in Considerations

The 11A33 is a differential plug-in and several of its parameters interact with one another. Therefore, modifying the value of one parameter might coerce one or more other 11A33 parameters. When such coercion occurs, no warning messages are reported. Also, there are certain circumstances under which parameter "X" is not possible because parameter "Y" is in effect. The following list describes those 11A33 parameters that interact with one another:

**PROTECT**—interacts with **IMPEDANCE** and **SENSITIVITY**. When **PROTECT** is **OFF** there are no side effects or restrictions. When **PROTECT** is **ON**, **SENSITIVITY** is restricted from 100 mV to 10 V and **IMPEDANCE** is restricted to 1 M $\Omega$  or 50  $\Omega$  (1 G $\Omega$  is disallowed). When **PROTECT** mode is enabled and **SENSITIVITY** is less than 100 mV, it will be set to 100 mV. If **IMPEDANCE** is 1 G $\Omega$  when **PROTECT** is enabled, **IMPEDANCE** will be coerced to 1 M $\Omega$ .

**PLSCOUPLING/MNSCOUPLING**—interact with **IMPEDANCE**. When either coupling parameter is **AC**, 1 G $\Omega$  **IMPEDANCE** is disallowed. Otherwise, coupling does not restrict **IMPEDANCE**. If either parameter is changed to **AC** when **IMPEDANCE** is 1 G $\Omega$ , **IMPEDANCE** will be set to 1 M $\Omega$ .

**IMPEDANCE**—interacts with **SENSITIVITY**, **PROTECT**, **PLSCOUPLING**, and **MNSCOUPLING**. If **PROTECT** is enabled or one of the coupling settings is **AC**, then 1 G $\Omega$  **IMPEDANCE** is disallowed regardless of the **SENSITIVITY**. If **PROTECT** is disabled, neither coupling is **AC**, **SENSITIVITY** is between 100 mV and 10 V, and **IMPEDANCE** is changed to 1 G $\Omega$ ; then **SENSITIVITY** will be changed to 99.5 mV before the **IMPEDANCE** is changed to 1 G $\Omega$ . Take note that setting **IMPEDANCE** to 1 M $\Omega$  or 50  $\Omega$  causes no parameter coercion under any circumstances.

**SENSITIVITY**—cannot coerce anything but may be limited by **PROTECT** and **IMPEDANCE**.

**Query Information:**

The general query form for the Channel command is

CH<slot><ui>?

This query causes the 11401/11402 to return the current parameters/settings of the specified channel for the specified plug-in slot. The information returned is dependent upon the type of amplifier installed in that slot.

**NOTE**

*In the following example query responses it is assumed that the currently loaded plug-in unit has the BWLO/BWHI functions. Hence, a BWLO and a BWHI argument are always shown in the response. However, if an 11000-series plug-in unit does not have this function, no BWLO/BWHI link will be returned. Instead, the BW link will be returned.*

For example, if the plug-in unit is not a differential amplifier, the query response is

```
CH<slot><ui>    COUPLING:<arg>,OFFSET:<NR3>,BWHI:<NR3>,BWLO:<NR3>,
                IMPEDANCE:<NR3>,PROBE:<qstring>,SENSITIVITY:<NR3>,
                UNITS:<qstring>
```

However, if the plug-in unit is a differential amplifier, the query response is

```
CH<slot><ui>    MNSCOUPLING:<arg>,PLSCOUPLING:<arg>,PROTECT:<arg>,
                OFFSET:<NR3>,AMPOFFSET:<NR3>,BWHI:<NR3>,BWLO:<NR3>,
                IMPEDANCE:<NR3>,MNSOFFSET:<NR3>,MNSPROBE:<qstring>,
                PLSOFFSET:<NR3>,PLSPROBE:<qstring>,SENSITIVITY:<NR3>,
                UNITS:<qstring>,VCOFFSET:<NR3>
```

**Error and Warning Conditions:**

An execution warning (event code 550) is issued if arguments are out of range for the AMPOFFSET, OFFSET, PLSOFFSET, MNSOFFSET, VCOFFSET, or SENSITIVITY links.

Attempting to set or query the parameters of plug-in slot that isn't loaded with an 11000 Series amplifier results in an execution error (event code 275).

Attempting to set or query a plug-in channel that doesn't exist results in an execution error (event code 263).

An execution error (event code 272) is returned when an attempt is made to set or query the BWHI or BWLO parameters of a plug-in unit that doesn't have these functions. This same error is returned when an attempt is made to set or query the BW parameter of a plug-in unit that supports BWHI/BWLO limits.

An execution error (event code 284) is returned when an attempt is made to set coupling to a setting which is not supported by the currently loaded plug-in unit. This same error is returned when an attempt is made to set a plug-in channel's coupling to a setting that is normally supported, but is not presently permitted because a Level 2 TEKPROBE™ has been connected to that channel. This error is also returned when an input channel is overloaded and an attempt



is made to set coupling to an otherwise valid setting that would worsen the overload.

An execution error (event code 285) is returned when an attempt is made to set a plug-in channel to an impedance value that is normally supported, but which is not presently permitted because a Level 2 TEKPROBE™ has been connected to that channel. This error is also returned when an input channel is overloaded and an attempt is made to set impedance to an otherwise valid value that would worsen the overload.

Attempting to set or query a PLSCOUPLING or MNSCOUPLING parameter for a nondifferential amplifier results in an execution error (event code 272). The same error is returned when an attempt is made to set or query the COUPLING parameter of a differential amplifier.

Attempting to set or query the AMPOFFSET, MNSOFFSET, PLSOFFSET, or VCOFFSET parameters of a nondifferential amplifier results in an execution error (event code 272).

Attempting to query the PLSPROBE or MNSPROBE parameters of a nondifferential amplifier results in an execution error (event code 272). This same error is returned when an attempt is made to query the PROBE parameter of a differential amplifier.

An execution warning (event code 558 or 559) is returned when an attempt is made to change the PLSOFFSET or MNSOFFSET of a differential plug-in unit and an offset-type probe is not connected to the plus or minus input of the specified channel.

Attempting to set/query the PROTECT parameter of a nondifferential amplifier results in an execution error (event code 272).

When an input signal overloads a plug-in unit's low impedance termination resistor, the plug-in unit changes its impedance to protect against this condition and reports an internal warning (event code 651).

When a plug-in unit's input signal is overdriven in a way that might distort the displayed signal, an internal warning (event code 652) is reported.

An internal error (event code 308) is returned when a plug-in unit detects that a Level 2 TEKPROBE™ has been improperly connected to an input channel. This same error is reported when a Level 2 probe is properly connected, but has malfunctioned.

An internal error (event code 397) is returned when a plug-in unit detects that a requested setting has overflowed an internal digital-to-analog converter (DAC). In this situation, the plug-in unit reverts to the nearest setting. This error usually indicates failed plug-in unit hardware.

An internal error (event code 396) is returned when the 11401/11402 detects that communication is no longer possible between the 11401/11402 and a particular plug-in unit. In this situation, the 11401/11402 may or may not continue to operate, depending upon the type of message that was in progress at the time that communication failure occurred. This error could indicate: failed

hardware, a software bug, or that a plug-in unit was removed from an energized 11401/11402 and plug-in communication was attempted with that empty compartment.

## CH<slot>? Query Command

This query-only command returns information regarding all channels of a specific plug-in unit, in the form:

```
CH<slot>1 <link>:<arg>[,<link>:<arg>]...];
CH<slot>2 <link>:<arg>[,<link>:<arg>]...];

CH<slot>n <link>:<arg>[,<link>:<arg>]...
```

### Error and Warning Conditions:

Attempting to query a plug-in slot that isn't loaded with an 11000-series amplifier results in an execution error (event code 275).

## CH? Query Command

This query-only command returns responses for all plug-in units that support the 11000 series plug-in interface.

The following example demonstrates a CH? query response (this example assumes that the 11401/11402 is configured with plug-in units in each of its slots):

```
CHL1 <link>:<arg>[,<link>:<arg>]...];
CHL2 <link>:<arg>[,<link>:<arg>]...];

CHLn <link>:<arg>[,<link>:<arg>]...];
CHC1 <link>:<arg>[,<link>:<arg>]...];
CHC2 <link>:<arg>[,<link>:<arg>]...];

CHCn <link>:<arg>[,<link>:<arg>]...];
CHR1 <link>:<arg>[,<link>:<arg>]...];
CHR2 <link>:<arg>[,<link>:<arg>]...];

CHRn <link>:<arg>[,<link>:<arg>]...
```

### Special Conditions

When the 11401/11402 is configured such that some (but not all) of its plug-in units do not support the 11000-series plug-in interface, the CH? query returns channel information for 11000-series plug-ins units only.

### Error and Warning Conditions:

When the 11401/11402 has no 11000-series plug-in units installed, a CH? results in an execution error (event code 274).

## Measurement Commands

Measurement commands execute and query waveform measurements, and set the references for measurements.

The set of selectable 11401/11402 waveform measurements is defined as:

<meas> ::= CROSS | DELAY | FALLTIME | FREQ | MAX | MEAN | MID | MIN |  
PDELAY | PERIOD | PP | RISETIME | RMS | TTRIG | WIDTH |  
YTENERGY | YTMNS\_AREA | YTPLS\_AREA

Header	Link	Argument	Notes
MSYS		ON   OFF	
MSLIST		<meas>   EMPTY	
MSNUM			1
MEAS			1
<meas>			1
REFSET	CURRENT: <meas>:	<meas> <NRx>	2
COMPARE		ON   OFF	
MESIAL		<NRx>	
PROXIMAL		<NRx>	
DISTAL		<NRx>	
REFLEVEL		<NRx>	
BASELINE		<NRx>	
TOPLINE		<NRx>	
DAINT		WHOLE   SINGLE	
SNRATIO		<NRx>	
MSLOPE		PLUS   MINUS	
LMZONE		<NRx>	
RMZONE		<NRx>	
MTRACK		ON   OFF	
TTAVERAGE		<NRx>	
DLYTRACE		TRACE<ui>	

Note 1. Query only, 2. Set-only link.

## The 11401/11402 Measurement Systems

The 11401/11402 has two measurement systems: one for GPIB/RS-232-C interface use and one for front-panel use, via the Measure menu. While these systems have many of the same measurement features, they do operate independently of one another. So, a GPIB or RS-232-C measurement can be made regardless of whether the Measure menu is currently displayed.

### NOTE

*In the following descriptions, remote measurement commands which have corresponding front-panel commands have only a brief explanation of their functions described here. Detailed explanations of these commands can be found in the "Operating Information" section.*

## Waveform Measurements and the Selected Trace

All waveform measurements are taken with respect to the currently selected trace. To select a particular trace, use the SELECT command described earlier in this section.

## MSYS Command

This command turns the measurement system on or off at the front panel display. However, it does not affect the ASCII interfaces' ability to take measurements via the MEAS? or <meas>? commands (see these commands below) when MSYS is OFF.

Turning MSYS ON has the same effect as pressing the front-panel MEASURE button when the Measurement menu is not currently displayed or when the menu status area is blank; That is, the currently displayed menu is replaced by the measurement menu and its status readouts.

Turning MSYS OFF has the same effect as pressing the MEASURE button when the Measurement menu is active, that is, removing the Measurement menu and it's status readouts from the menu/status area.

- A **FREQ** or **PERIOD** measurement is attempted and no period can be found within the specified measurement zone.
- A **MEAN**, **RMS**, **YTPLS\_AREA**, **YTMNS\_AREA**, or **YTENERGY** measurement is attempted and **DAINT** is **SINGLE** and no period can be found within the specified measurement zone.
- A **CROSS** measurement is attempted and **REFLEVEL** does not fall within the specified measurement zone.
- A **RISETIME** measurement is attempted and the measurement system cannot compute a valid proximal time, followed by a valid distal time, within the specified measurement zone.
- A **FALLTIME** measurement is attempted and the measurement system cannot compute a valid distal time followed by a valid proximal time, within the specified measurement zone.
- A **WIDTH** measurement is attempted and two mesial crossings of opposite slope cannot be found within the specified measurement zone.
- No traces are defined on the 11401/11402's display (i.e., there is no selected trace) and any measurement is attempted.
- A **PDELAY** measurement is attempted and only one trace is defined (**PDELAY** requires at least two traces on the screen).

### Signaling Operation Complete

Since **TTRIG** measurement calculations can consume a considerable amount of time, successful completion of a **MEAS?** containing a **TTRIG** measurement is signaled via an operation complete event (event code 463). No other measurements require or report an operation complete event.

### Special Conditions

If the **MSLIST** is not **EMPTY** and there is no selected trace, **MEAS?** returns a list of meaningless measurement values. Each returned value is flagged with an **ER** qualifier.

## <meas>? Query Command

This query-only command executes the specified measurement and returns its value with the appropriate accuracy qualifier.

The response form is

```
<meas> <NR3>,<qual>
```

<meas> is the selected measurement (from the set of 11401/11402 measurements) and <qual> is as described in the **MEAS?** command.

For example, to return the frequency of the currently selected trace, use this query:

FREQ?

The response will be

FREQ <NR3>,<qual>

**Signaling  
Operation  
Complete**

As in the MEAS? command, the TTRIG measurement can consume a considerable amount of time and is the the only measurement that generates an operation complete event upon successful completion.

## REFSET Command

Sets the reference value for measurements. References are used when measurements are returned in comparison mode.

**Parameters:**

**CURRENT**—causes the measurement to be executed and the resultant value stored as the measurement reference.

**<meas>**—sets the reference for the specified measurement (again, from the set of 11401/11402 measurements) to a user-defined value. The valid range is any legal <NRx> value.

**Query  
Information:**

REFSET? returns the reference values for all measurements.

REFSET <meas>:<NR3>[{<meas>:<NR3>}...]

**Signaling  
Operation  
Complete**

Successful completion of a REFSET CURRENT:TTRIG command signals an operation complete event (event code 463). This is the only REFSET computation for which an operation complete event is generated.

**Error and Warning  
Conditions:**

An execution error (event code 290) is returned when a CURRENT reference cannot be computed. The conditions that cause CURRENT reference calculation failures are the same as those that cause MEAS? to return an ER qualifier (see above).

## MTRACK Command

Turns measurement tracking on or off. If ON, histograms are calculated and used to set TOPLINE and BASELINE. If OFF, the user sets those parameters.

**Query Information:** The query form, MTRACK? , returns the current state of measurement tracking.

MTRACK <arg>

**Error and Warning Conditions:** An execution error (event code 250) is returned when there is no selected trace and an attempt is made to query or set MTRACK.

## TTAVERAGE Command

Sets the number of averages for the trigger-to-trigger measurement (TTRIG). The value set applies to all traces. This command may be set to one of the four values shown in Table 3-12:

**TABLE 3-12**  
**TTRIG Measurement Operation**

Value	Semantics
1	Single-shot mode.
10	Averaged 10 times before a final value is reported.
100	Averaged 100 times before a final value is reported.
1000	Averaged 1000 times before a final value is reported.

**Query Information:** TTAVERAGE? returns the currently selected value for averaging the TTRIG measurement.

TTAVERAGE <NR1>

**Error and Warning Conditions:** An execution warning (event code 550) is returned for out of range TTAVERAGE arguments.

## DLYTRACE Command

DLYTRACE selects a delayed trace for the PDELAY measurement. This command's <ui> argument must be greater than or equal to 0 (zero) and less than or equal to 8. In the special case of a 0<ui> argument, the delayed trace is ignored (treated as a NOP).

Take note that the DLYTRACE command must not be used to specify a delayed trace number that is identical to the currently selected trace. That is to say, proper operation of the PDELAY measurement requires two unique traces: the selected trace and a second, "delayed" trace, which is specified with DLYTRACE.

### Query Information:

DLYTRACE? returns the currently selected argument, in the form:

DLYTRACE TRACE<ui>

When there is no delayed trace (i.e., less than two traces are displayed on the screen), DLYTRACE TRACE0 is returned.

### Error and Warning Conditions:

An execution error (event code 251) is returned for out of range TRACE<ui> arguments.

An execution error (event code 250) is returned when there is no selected trace and an attempt is made to query or set DLYTRACE.

An execution error (event code 233) is returned when an attempt is made to specify the currently selected trace as the PDELAY delayed trace.



## Special PDELAY Considerations

PDELAY measures the absolute time between the mesial crossings of the currently selected trace (referred to here as the primary trace) and a user-specified delayed trace.

While changing the measurement parameters (MESIAL, TOPLINE, etc.) of the primary trace is straightforward, changing the measurement parameters of the delayed trace requires a bit more effort. To accomplish this task, first use the SELECT command to specify the delayed trace as the currently selected trace. Modify the measurement parameters of this trace as necessary and then re-SELECT the primary trace. At this point, PDELAY can be used to measure the time between the mesial crossings of the primary and delayed trace.

For example, suppose it was desired to measure the PDELAY between TRACE2 and TRACE4 and suppose the required MESIAL values of these two traces were 40% and 45%, respectively. The following commands produce the desired measurement:

```

SELECT TRACE2
MESIAL 40          /* Specify primary trace's MESIAL value */
DLYTRACE TRACE4  /* Specify primary trace's delayed trace */
SELECT TRACE4     /* Temporarily change selected trace */
MESIAL 45         /* Specify delayed trace's MESIAL value */
SELECT TRACE2     /* Re-SELECT primary trace */
PDELAY?           /* Measure PDELAY between TRACE2 & TRACE4
                  * Primary trace is TRACE2
                  * Delayed trace is TRACE4
                  */

```

## Status and Event Commands

Status and Event commands control the reporting of the 11401/11402's operating status to an external controller or device.

Header	Link	Argument	Notes
RQS		ON   OFF	
SRQMASK	CALDUE: CMDERR: EXERR: EXWARN: IDPROBE: INERR: INWARN: OPCMPL: USER:	ON   OFF ON   OFF ON   OFF ON   OFF ON   OFF ON   OFF ON   OFF ON   OFF ON   OFF	
STBYTE			1
EVENT			1
ID			1
IDPROBE			1
PIVERSION			1
CONFIG			1
UID	MAIN: LEFT: CENTER: RIGHT:	<qstring> <qstring> <qstring> <qstring>	2 2 2 2

Notes

1. Query-only.
2. <qstring> argument may not exceed 10 characters; longer strings are truncated.

## CONFIG? Query Command

This query-only command returns identifying information about the plug-in unit names, thus aiding determination of system configurations.

The response form is

```
CONFIG LEFT:"<name>",CENTER:"<name>",RIGHT:"<name>"
```

If a particular plug-in compartment is empty, its name is returned as "N/7K".

## UID Command

The Unit IDentification command sets or queries the serial numbers of the 11401/11402, and its plug-in units. When setting a UID value, no serial number may exceed 10 characters. Serial numbers that exceed 10 characters are truncated and no error is reported.

The setting of this command is, typically, disabled by a factory-set internal hardware strap. If setting serial numbers is desired, authorized service personnel should refer to the 11401/11402 Service Manuals for details. However, serial numbers may always be queried, regardless of the strap setting.

### Query Information:

The general query response depends upon the number of 11000-series plug-in units that are loaded in the 11401/11402's plug-in compartments. When all compartments are loaded, the query is

```
UID MAIN:<qstring>,LEFT:<qstring>,CENTER:<qstring>,RIGHT:<qstring>
```

Otherwise, if a given compartment is not loaded with an 11000-series plug-in unit, the corresponding link for that compartment is omitted.

### Error and Warning Conditions:

An execution error (event code 292) is returned when an attempt is made to set or query the serial number of a plug-in compartment that is not loaded with an 11000-series plug-in unit.

An execution error (event code 243) is returned when the hardware strap is disabled and an attempt is made to modify a serial number.

## External I/O Interface Commands

External input and output commands manipulate the 11401/11402's GPIB, RS-232-C, and Centronics I/O ports.

Header	Link	Argument	Notes
RS232	BAUD: DELAY: ECHO: EOL: FLAGGING: PARITY: STOPBITS: VERBOSE:	<NRx> <NRx> ON   OFF CR   CRLF   LF   LFCR SOFT   HARD   OFF ODD   EVEN   NONE <NRx> ON   OFF	
COPY	PRINTER: FORMAT:	ABORT START PIN8   PIN24 DRAFT   HIRES   REDUCED	1 1
DEBUG	GPIB: RS232:	ON   OFF ON   OFF	

Note

1. Set-only argument.

### RS-232-C Command

Sets or queries RS-232 interface parameters.

#### NOTE

*See the "Special RS-232-C I/O Considerations" information for related information.*

#### Parameters:

**BAUD**—selects the baud rate for the RS-232-C interface port. Both transmit and receive baud rates are set by this command. The valid rates are 110, 150, 300, 600, 1200, 2400, 4800, 9600, and 19200.

**DELAY**—sets the minimum delay from receipt of an RS-232-C query to its response. This command allows an RS-232-C controller time to prepare to receive the response from a query before the response is transmitted. The argument represents the minimum delay in seconds, with minimum granularity of 20 milliseconds. The valid range is from 0 to 60 seconds.

**ECHO**—turns RS-232-C echo on or off. When echo is on, all characters received from the RS-232-C port are echoed. When echo is off, input characters are not echoed.

**FLAGGING**—controls input and output flagging over the RS-232-C port. When flagging is turned OFF, the 11401/11402 does not respond to any transmission control on output and does not send any transmission control on input.

When SOFT flagging is enabled, the 11401/11402 stops transmitting data any time it receives an XOFF (DC3) character and the instrument sends an XOFF character when its input buffer is 3/4 full. The 11401/11402 begins transmitting data again when it receives an XON (DC1) character and it sends XON when its input buffer is 1/4 full.

Notice that there are potential conflicts when using soft handshaking with binary data transfers, since binary data may contain XON and XOFF characters. Generally, binary data transfers should not be used with soft handshaking unless the user can be sure that the data does not contain XON or XOFF characters.

When HARD flagging is selected, the 11401/11402 uses the DTR (Data Terminal Ready) and CTS (Clear to send) lines to control data transmission. On output, the instrument transmits data only when DTR is asserted. When DTR is not asserted, the instrument stops transmitting data. On input, the 11401/11402 asserts CTS until the input buffer is 3/4 full. Then it unasserts CTS to stop transmission from an external controller. CTS remains unasserted until the input buffer is 1/4 full, at which time CTS is asserted again to restart transmission.

**PARITY**—selects the parity used for all RS-232-C data transfers. The 11401/11402 generates the selected parity on output and checks all input against the selected parity. When parity is ODD or EVEN, and an input parity error is detected, an internal error warning (event code 653) is returned. When parity is NONE, no input parity error checks are performed and no output parity is generated.

**STOPBITS**—selects the number of transmission stop bits sent with each character to identify the end of data for that character. Valid selections are 1, 1.5, or 2 stop bits.

**EOL**—selects the type of End Of Line string that terminates each query transmitted from the 11401/11402 to its RS-232-C port. Possible EOL string selections include:

CR	→	Carriage Return
LF	→	Line Feed
CRLF	→	CR followed by a LF
LFCR	→	LF followed by a CR

**VERBOSE**—sets whether the 11401/11402 returns error and warning messages when they occur (RS232 VERBOSE:ON), or whether the 11401/11402 must be queried for event messages.

**Query Information:** The general query form, RS232? , returns all links and their currently selected arguments, in the form:

RS232 BAUD:<NR1>,DELAY:<NR3>,ECHO:<arg>,EOL:<arg>,FLAGGING:<arg>,  
PARITY:<arg>,STOPBITS:<NR2>,VERBOSE:<arg>

**Error and Warning Conditions:** An execution warning (event 550) is issued if set arguments are out of range for the BAUD, DELAY, or STOPBITS links.

## COPY Command

Transmits a copy of the front panel display to the 11401/11402's PRINTER (Centronics) port.

Completion of the copy operation is signaled with operation complete event 462.

**Parameters:** **START**—initiates a copy of the front-panel display. COPY START may be abbreviated to simply COPY (i.e., COPY without arguments is identical to the command "COPY START"). Take note that if a second COPY command is sent to the instrument before a prior COPY has been completely queued for output, the second command aborts the prior COPY.

**ABORT**—dequeues all queued COPY requests and aborts any COPY operation currently in progress. Completion of the ABORT operation is signaled via an operation complete event (event code 458).

**FORMAT**—selects the output format produced by COPY [START]. Choices are HIRES, DRAFT, and REDUCED. HIRES copies are approximately 8.5 inches by 11 inches and, as the name suggests, yield the greatest front-panel detail of the three possible formats. DRAFT copies are similar to HIRES copies except that no over-striking is used to depict front-panel intensified regions. REDUCED copies are much smaller than DRAFT or HIRES copies and show absolutely no front-panel intensified regions.

**PRINTER**—selects the target printer. PIN8 selects a printer that supports the standard EPSON command set. Examples of such printers include the Tektronix 4644 and EPSON EX-800. PIN24 selects a printer that supports the extended EPSON command set (often referred to as a "letter quality" dot matrix printer). The EPSON LQ-1500 is an example of such a printer.

**Query Information:** The general query form COPY? returns all links and their currently selected arguments, as follows:

COPY FORMAT:<arg>,PRINTER:<arg>

**Error and Warning Conditions:** When a COPY command is attempted and either a printer is not connected to the PRINTER port or the currently connected printer is offline, an execution error (event code 287) is returned and no copy is made.

When multiple COPY [START] commands cause a copy operation to be aborted, an execution warning (event code 557) is reported.

If COPY ABORT is attempted and there is nothing to abort, an execution warning (event code 558) is reported.

## DEBUG Command

This command copies input data from the selected interface to the front panel display for program development troubleshooting. The incoming ASCII commands are displayed in the 11401/11402's "Error/Message" area (top two lines of the screen).

With DEBUG ON, artificial delays are inserted in the input stream to prevent commands from rapidly scrolling off the display. This does reduce the GPIB and/or RS-232-C throughput to some degree.

Unprintable input data (e.g., control characters, CR and LF) are displayed in snoopy mode (i.e., two- or three-character mnemonics that represent nonprinting ASCII control characters). A GPIB EOI interface signal is displayed as "<EOI>".

An input message terminator causes the front-panel Error/Message area to be cleared when the next input command is received.

If an error occurs during input, the erroneous item is displayed first, followed by the event code describing that type of error (see "Status and Event Reporting"), in the form:

<EVENT ddd>...

where ddd is the numeric (decimal) event code. Further command input is flushed until a synchronizing delimiter is encountered.

GPIB or RS-232 DCL commands clear the front-panel Error/Message area. A DCL command, itself, is displayed as "<DCL>..."

Binary settings and binary curve data are not displayed when DEBUG mode is enabled. However, ASCII curve data (waveform transmissions) are displayed.

### Parameters:

**RS232**—enables or disables the debug function for this interface.

**GPIB**—enables or disables the debug function for this interface.

### Query Information:

The general query form, DEBUG?, returns all links and their currently selected arguments.

DEBUG GPIB:<arg>,RS232:<arg>

### INITIALize Side Effects

The INIT command disables both GPIB and RS-232-Cdebug, assuming either was enabled.

## Calibration Commands

Calibration commands initiate the 11401/11402's self-calibration feature and report on their various conditions.

Header	Link	Argument	Notes
SELF CAL	MODE:	FORCE AUTO   MANUAL	1
CALSTATUS			2
MCALCONSTANTS	<ui>:	<NRx>	
CCALCONSTANTS	<ui>:	<NRx>	
LCALCONSTANTS	<ui>:	<NRx>	
RCALCONSTANTS	<ui>:	<NRx>	

### Notes

1. Set-only argument
2. Query-only link.

## SELF CAL Command

Selects the mode of calibration or forces calibration to occur.

### Parameters:

The FORCE argument causes the 11401/11402 to immediately perform its self-calibration procedures. Successful completion of calibration is signaled via operation complete event 461.

MODE—selects whether the selfcal is performed AUTOMATICALLY, when it is due, or upon user initiation with the FORCE argument under the MANUAL mode.

### Self-Calibration Sequence of Operations

There are two major levels of accuracy: enhanced, Not-Enhanced.

The 11401/11402 returns optimal measurements and settings in the enhanced state.

At power up, checks are made to determine if any resident plug-in units haven't been calibrated since the last power up. Also, checks are made to determine if the 11401/11402 nonvolatile RAM contains corrupted digitizer constants. If either condition exists, the 11401/11402 enters the new-configuration state and posts event 466 indicating such. Then, it performs a partial calibration of all uncalibrated plug-in units and the digitizer, as necessary. Successful completion of this operation generates an operation complete event (code 461).





When the FIFO is empty (no touches buffered), ABSTOUCH? returns:

ABSTOUCH -1, -1

When more than 20 touches accumulate, (i.e., the FIFO overflows), the oldest buffered touch is discarded and the newest touch is placed at the end of the FIFO.

### Error and Warning Conditions:

An execution error (event code 205) is issued when ABSTOUCH arguments do not fall within the range of the touch panel grid.

## INIT Command

This set-only command initializes the oscilloscope to its factory-assigned default parameters/settings. With respect to the ASCII interfaces, INIT has these effects:

- GPIB and RS-232-C debug are disabled.
- The GPIB and RS-232 USER SRQMASKs are turned OFF. This action removes the RQS icon, assuming it was displayed.
- All pending events, except "Power On" are discarded.
- GPIB RQS is turned ON.

For more details, see the "Initialize" function description in the Operating Information, earlier in this manual.

## LONGFORM Command

This command has three major functions:

1. LONGFORM enables or disables abbreviated query responses. When LONGFORM is ON, all command reserved words are returned in their fully unabbreviated form (see Table 3-17 for the abbreviation information). When LONGFORM is OFF, reserved words are returned fully abbreviated.

As an example, assume the following commands are sent to the 11401/11402:

```
ENCDBG SET: BINARY, WAVFRM: ASCII
LONGFORM ON; ENCDBG?; LONGFORM OFF; ENCDBG?
```

The query response from this example looks like so:

```
ENCDG SET:BINARY,WAVFRM:ASCII;ENC SET:BIN,WAV:ASC
```

#### NOTE

*LONGFORM has no effect upon abbreviated reserved words received at the 11401/11402's RS-232-C/GPIB ports. The 11401 always accepts correctly abbreviated reserved words regardless of the state of LONGFORM.*

2. LONGFORM controls the response returned by EVENT? query. When LONGFORM is ON, the response to an EVENT? query contains a numeric event code as well as a brief text string explaining the event code. When LONGFORM is OFF, the EVENT? query response is just an event code. See the description of EVENT? for more details.
3. LONGFORM controls the RS-232 VERBOSE response when an error is returned to the RS-232-C port. When LONGFORM is ON, the response contains both a numeric event code and an event description string. When LONGFORM is OFF, the response is simply an event code.

By default, both the RS-232-C and the GPIB have LONGFORM enabled at 11401/11402 powerup.

#### Query Information:

LONGFORM? returns the currently selected argument, in the form:

```
LONGFORM <arg>
```

## DATE Command

Sets the date on the 11401/11402's internal calendar. Within the quoted string argument, proper date syntax is

```
"<DD><MON><YY>";
```

where:

```
<DD>      ::= day of the month
<MON>    ::= first three letters of the month
<YY>     ::= last two digits of the year
```

#### Query Information:

DATE? returns the calendar's date day, month, and year, in the form:

```
DATE <qstring>
```

#### Error and Warning Conditions:

An execution error (event code 265) is returned if an illegal date value is specified or if the specified syntax is incorrect.

## TIME Command

Sets the time-of-day on the 11401/11402's clock. Within the quoted string argument, proper time syntax is

"<HH>:<MM>:<SS>",

where:

<HH> ::= hours in 24-hour format

<MM> ::= minutes of the hour

<SS> ::= seconds of the minute

### Query Information:

TIME? returns the clock's time in hours, minutes, and seconds, in the form:

TIME <qstring>

### Error and Warning Conditions:

An execution error (event code 265) is returned if an illegal time value is specified or if the specified syntax is incorrect.

## UPTIME? Query Command

This query-only command returns the total number of hours the 11401/11402 has been powered up.

The query response is

UPTIME <NR3>

## POWERON? Query Command

This query returns the total number of times the 11401/11402 has been powered up.

The query response is

POWERON <NR1>

## Abbreviating Reserved Words

When transmitting a reserved word to the 11401/11402's ASCII ports, the first three letters of each reserved word must generally be specified before the reserved word can be recognized. In the few cases where two reserved words begin with the same letters, more than three letters may be required to distinguish between them.

Any leading substring of the full reserved word will be accepted as input, so long as the minimum string is given.

Examples:

What follows is a table of valid commands that are shown with and without reserved word abbreviations. The left side of the table specifies a command in which no abbreviation occurs. The right side of the table specifies the same command in its most abbreviated form.

**TABLE 3-16**  
**Command Abbreviation Comparison**

Nonabbreviated Command	Fully Abbreviated Command
TRACE1 DESCRIPTION:"L1" DIGITIZER STOP TBMAIN? LENGTH BASELINE?;TOPLINE?;DISTAL? DISPLAY MODE:VECTORS TRMAIN TIHOLDOFF:1e-2;TRMAIN?	TRA1 DES:"L1" DIG STOP TBM? LEN BAS?;TOP?;DIST? DISP MOD:VEC TRM TIH:1e-2;TRM?

**TABLE 3-17**  
**Reserved Words and Abbreviations**

ABBwfmpre	DAInt	GPib
ABStouch	DATE	GRAticule
AC	DC	GRLocation
ACCumulate	DCHf	GRType
ACHf	DCNoise	GT
ACLf	DEBug	
ACNoise	DEF	H1Bar
ACState	DELAy	H2Bar
ADJtrace	DELeTe	HARd
ALEvel	DEScRiption	HBArs
ALL	DIAg	HIPrec
ALL_Wavfrm	DIGitizer	HMAg
AMPoffset	DISPlay	HORiz
AMPS	DISTal	HPOsition
ANLevel	DIVS	
ASCii	DOT1Abs	ID
AUTO	DOT2Abs	IDProbe
AUTOLevel	DOT1Rel	IMPedance
AUTOSet	DOT2Rel	INErr
AVG	DOTs	INIt
	DSYmenu	INPut
	DUA1	INTensity
		INWarn
BASeline	ECHo	
BAUd	ECL	LCAconstants
BINary	EMPTy	LEFt
BIT/nr	ENCdg	LENgth
BN.fmt	ENHanced	LEVel
BOTH	ENV	LF
BW	EOL	LFCr
BWHi	EQ	LINear
BWLo	EVEN	LMZone
BYPassed	EVENT	LONGform
BYT.or	EVHoldoff	LOWer
BYT/nr	EXErr	LSB
	EXWarn	LT
CCAconstants		
CALDue	FALled	MAIn
CALStatus	FALltime	MAINPos
CENter	FASt	MANual
CH	FEOi	MAX
CHKsm0	FIL1	MCAconstants
CLEar	FLAgging	MEAN
CMDerr	FORce	MEAS
COMpare	FPAnel	MESial
CONDacq	FPNext	MID
CONFig	FPS	MIN
CONTinuous	FPSList	MINUs
COPy	FPSNum	MNScoupling
COUpling	FPUdate	MNSOffset
CR	FREquency	MNSProbe
CRLf		MODe
CROss		MSB
CRVchk		MSList
CURRent		
CURSor		
CURVe		

TABLE 3-17 (cont)  
Reserved Words and Abbreviations

MSLOpe	RIght	UID
MSNum	RISetime	UN
MTRack	RMS	UNDEF
MSYs	RMZone	UNDO
	RQS	UNIts
NAVg	RS232	UPPer
NENV	RUN	UPTime
NENHanced		USEr
NEWconfig	SEConds	UTility
NLevel	SElect	
NONe	SELFcal	V1Bar
NORmal	SENsitivity	V2Bar
NOTrg	SET	VBArS
NR.pt	SETSeq	VC
NT	SINgle	VCOffset
NTAuto	SLOpe	VECTors
NUL1	SNRatio	VERBoSe
NVRam	SOft	VERt
	SOUrce	VOLts
ODD	SPEaker	VPOsition
OFF	SPLit	VSize
OFFSet	SRQMask	
OHMs	STARt	WATts
ON	STAtus	WAVfrm
OPCmpl	STByte	WFId
OPTional	STO	WFMpre
OUTput	STOList	WFMCalc
	STONum	WFMScaling
PAIred	STOP	WHOLe
PANzoom	STOPBits	WIDth
PARity	STORE	WIN1Pos
PASSed	STORE_Recall	WIN2Pos
PCTg	STRing	WTMode
PERiod		
PIVersion	TBMain	X
PLSCoupling	TBWin	XCOord
PLSOffset	TEST	XDIv
PLSProbe	TEXT	XINcr
PLUs	TIHholdoff	XMULt
POWeron	TIME	XQUal
PP	TOPline	XTNd
PROBe	TR	XUNit
PROXimal	TRAcE	XY
PT.fmt	TRANUm	XZEro
	TRG	
RCAIconstants	TRIGger	Y
REAdout	TRMain	YCOrd
RECall	TRSep	YDIv
REFERENCE	TRWin	YMUlt
REFLevel	TTAverage	YQUal
REFset	TTL	YTMns_area
REMAining	TTRig	YTP1s_area
REMOve	TYPe	YTEnergy
RI		YUNit
		YZEro

# 11401/11402 Character Set

## ASCII Character Set

The character set shown in the following table is the 11401/11402's ASCII character set, which comprises the set of nonescaped characters that may be displayed on the 11401/11402's front panel display.

**TABLE 3-18**  
**ASCII Character Set**

	0	1	2	3	4	5	6	7
0	0 N	16 D	32	48 0	64 @	80 P	96 '	112 p
1	1 H	17 D <sub>1</sub>	33 !	49 1	65 A	81 Q	97 a	113 q
2	2 X	18 D <sub>2</sub>	34 "	50 2	66 B	82 R	98 b	114 r
3	3 E	19 D <sub>3</sub>	35 #	51 3	67 C	83 S	99 c	115 s
4	4 T	20 D <sub>4</sub>	36 \$	52 4	68 D	84 T	100 d	116 t
5	5 E	21 N <sub>k</sub>	37 %	53 5	69 E	85 U	101 e	117 u
6	6 k	22 S <sub>y</sub>	38 &	54 6	70 F	86 V	102 f	118 v
7	7 L	23 E <sub>b</sub>	39 '	55 7	71 G	87 W	103 g	119 w
8	8 S	24 C <sub>H</sub>	40 (	56 8	72 H	88 X	104 h	120 x
9	9 H	25 E <sub>H</sub>	41 )	57 9	73 I	89 Y	105 i	121 y
A	10 F	26 S <sub>B</sub>	42 *	58 :	74 J	90 Z	106 j	122 z
B	11 V	27 E <sub>C</sub>	43 +	59 ;	75 K	91 [	107 k	123 {
C	12 F	28 F <sub>S</sub>	44 ,	60 <	76 L	92 \	108 l	124 l
D	13 C <sub>R</sub>	29 E <sub>S</sub>	45 -	61 =	77 M	93 ]	109 m	125 }
E	14 S <sub>O</sub>	30 R <sub>S</sub>	46 .	62 >	78 N	94 ^	110 n	126 ~
F	15 S <sub>I</sub>	31 U <sub>S</sub>	47 /	63 ?	79 O	95 _	111 o	127 o



**TABLE 3-21 (cont)**  
**Formatting Symbols**

Symbol	Expand With The:
%T	time, formatted as "X minutes and Y seconds." If X is 0, then 'X minutes' is omitted. If Y is 0, then 'Y seconds' is omitted.
%?	event code value.

**TABLE 3-22**  
**Command Errors**

Event Code	SRQMASK	Status Byte		Event Code Description String
		RQS ON	OFF	
108	CMDERR	97	33	Checksum error in binary block transfer
109	CMDERR	97	33	Illegal byte count value on a binary block transfer
154	CMDERR	97	33	Invalid number input
155	CMDERR	97	33	Invalid string input
156	CMDERR	97	33	Symbol not found
157	CMDERR	97	33	Syntax error
160	CMDERR	97	33	Expression too complex
161	CMDERR	97	33	Excessive number of points in binary CURVE data input
162	CMDERR	97	33	Excessive number of points in ASCII CURVE data input
163	CMDERR	97	33	No input terminator seen
164	CMDERR	97	33	Binary block input not allowed with ECHO ON
167	CMDERR	97	33	Insufficient data to satisfy binary block byte count
168	CMDERR	97	33	Unsupported constant
169	CMDERR	97	33	Unsupported function

**TABLE 3-23**  
**Execution Errors**

Event Code	SRQMASK	Status Byte		Event Code Description String
		RQS	ON—OFF	
203	EXERR	98	34	I/O buffers full
205	EXERR	98	34	%A argument out of range—value ignored
224	EXERR	98	34	Function not available in selected plugin range
233	EXERR	98	34	Delayed trace must not be the selected trace
239	EXERR	98	34	Improper version number
240	EXERR	98	34	Can't accumulate nonacquired waveform
241	EXERR	98	34	Too many acquisitions
242	EXERR	98	34	Enhanced Accuracy available after %T
243	EXERR	98	34	That function is disabled by a hardware strap
244	EXERR	98	34	%B plugin channel(s) used differently in main and window sources
246	EXERR	98	34	Can't sequence settings
247	EXERR	98	34	No settings defined
248	EXERR	98	34	Misuse of AVG/ENV function
249	EXERR	98	34	Illegal use of trace positioning function
250	EXERR	98	34	No traces defined
251	EXERR	98	34	Illegal trace number
252	EXERR	98	34	Illegal stored settings number
255	EXERR	98	34	Out of memory
257	EXERR	98	34	Illegal stored waveform number
263	EXERR	98	34	Illegal channel number
264	EXERR	98	34	No further XY waveforms may be defined
265	EXERR	98	34	Illegal DATE/TIME
266	EXERR	98	34	DEF expansion overflow
267	EXERR	98	34	Illegal DEF string
268	EXERR	98	34	Illegal DEF recursion
269	EXERR	98	34	No such trace
270	EXERR	98	34	No such stored waveform
271	EXERR	98	34	No such DEF
272	EXERR	98	34	That function is not supported by this plugin
273	EXERR	98	34	No such FPS
274	EXERR	98	34	No appropriate 11K plugins loaded
275	EXERR	98	34	%B slot not loaded with appropriate 11K plugin
278	EXERR	98	34	Plugin channel used more than once in trigger source
279	EXERR	98	34	Line trigger not available for window trigger source

TABLE 3-23 (cont)  
Execution Errors

Event Code	SRQMASK	Status Byte		Event Code Description String
		RQS ON	OFF	
280	EXERR	98	34	Invalid smooth argument
281	EXERR	98	34	Can't delete active stored waveform
282	EXERR	98	34	Can't store trace
283	EXERR	98	34	Can't clear nonacquired waveform
284	EXERR	98	34	Requested coupling for channel %a not available on %B plugin
285	EXERR	98	34	Requested input impedance for channel % a not available on %B plugin
286	EXERR	98	34	Too many measurements specified
287	EXERR	98	34	Hardcopy absent or off line
288	EXERR	98	34	Inappropriate trigger level units
289	EXERR	98	34	Split cursors not permitted on XY trace
290	EXERR	98	34	Current reference measurement failed
291	EXERR	98	34	TEXT not permitted when acquired XY trace is active
292	EXERR	98	34	%B slot not loaded with 11K plug-in unit
293	EXERR	98	34	Misuse of 11K plugin unit
294	EXERR	98	34	Dual graticules not permitted with XY trace
295	EXERR	98	34	Record length too long for Point Accumulate waveform
296	EXERR	98	34	Point Accumulate and XY waveforms are mutually exclusive
297	EXERR	98	34	Panzoom may not be enabled
298	EXERR	98	34	Panzoom may not be disabled
299	EXERR	98	34	CONDACQ function not available

TABLE 3-24  
Internal Errors

Even Code	SRQMASK	Status Byte		Event Code Description String
		RQS ON	OFF	
308	INERR	99	35	Bad level 2 probe checksum on channel %b%a
327	INERR	99	35	DIG probe compensation failed
328	INERR	99	35	DIG plugin calibration failed
329	INERR	99	35	DIG deskew failed
330	INERR	99	35	Calibration failed. Plugin fault(s): %P. Mainframe fault: %M.
394	INERR	99	35	Test completed and failed
395	INERR	99	35	General DIG failure detected (code=%a)

**TABLE 3-24 (cont)**  
**Internal Errors**

Event Code	SRQMASK	Status Byte		Event Code Description String
		RQS ON	OFF	
396	INERR	99	35	%B plugin communication failure
397	INERR	99	35	Internal DAC overflow on channel %a of %B plugin
398	INERR	99	35	Invalid DIG table ID detected
399	INERR	99	35	Invalid DIG field ID detected

**TABLE 3-25**  
**System Events**

Event Code	SRQMASK	Status Byte		Event Code Description String
		RQS ON	OFF	
400	—	0	0	System function normal
401	—	65	1	Power on
403	USER	67	3	Front panel RQS icon selected
450	OPCMPL	66	2	Conditional acquire completed
457	IDPROBE	67	3	Probe %a ID button pressed on %B plugin
458	OPCMPL	66	2	Hardcopy aborted
460	OPCMPL	66	2	Test completed and passed
461	OPCMPL	66	2	Calibration complete and passed
462	OPCMPL	66	2	Hardcopy complete
463	OPCMPL	66	2	Measurements complete
464	OPCMPL	66	2	Autoset complete
465	CALDUE	70	6	Warmup complete. Calibration due
466	CALDUE	70	6	Powerup new configuration partial calibration occurring.
467	CALDUE	70	6	Warmup complete. New configuration requires calibration. Calibration due.
468	CALDUE	70	6	Warmup complete. New configuration requires calibration. Automatic calibration occurring.
469	CALDUE	70	6	Temperature change since previous calibration. Automatic calibration occurring.
470	CALDUE	70	6	Temperature change since previous calibration. Calibration due.
471	CALDUE	70	6	Warmup complete. Enhanced Accuracy in effect.
472	CALDUE	70	6	Automatic calibration occurring

**TABLE 3-26**  
Execution Warnings

Event Code	SRQMASK	Status Byte		Event Code Description String
		RQS ON	—OFF	
550	EXWARN	101	37	%A argument out of range—limit set
551	EXWARN	101	37	Insufficient data to satisfy binary block byte count
552	EXWARN	101	37	Checksum error in binary block transfer
553	EXWARN	101	37	Window trigger source set equal to main trigger source
554	EXWARN	101	37	No signal detected—AUTOSET terminated
555	EXWARN	101	37	Binary curve odd data byte discarded
556	EXWARN	101	37	No active acquisitions—digitizer remains stopped
557	EXWARN	101	37	Hardcopy aborted
558	EXWARN	101	37	Nothing to abort
560	EXWARN	101	37	AUTOSET failed

**TABLE 3-27**  
Internal Warnings

Event Code	SRQMASK	Status Byte		Event Code Description String
		RQS ON	—OFF	
651	INWARN	102	38	Input channel %a overload on %B plugin
652	INWARN	102	38	Input channel %a overdrive on %B plugin
653	INWARN	102	38	RS-232-C input parity error
654	INWARN	102	38	RS-232-C input framing error
655	INWARN	102	38	RS-232-C input buffer overrun
656	INWARN	102	38	Internal table search failed
657	INWARN	102	38	Nonvolatile RAM completely reset
658	INWARN	102	38	Nonvolatile RAM front panel settings lost; instrument ID data retained
659	INWARN	102	38	Cannot report unknown error code (%?)
660	INWARN	102	38	Digitizer stopped — time base settings exceed available acquisition memory.

## System Event Handling

Status bytes and event codes combine to represent common instrument system events (see Fig. 3-16 at the beginning of this discussion of the "Status and Event Reporting" system).

The system events that are generated by the 11401/11402 are handled as either "port dependent" or "port independent" events.

### Port Dependent Events

A port dependent event is generated when any of the following system status conditions occur:

- Command Error
- Execution Error
- Execution Warning

Port dependent events are returned only to the port responsible for the event. For example, if the 11401/11402 detects a command error in an RS-232-C device dependent command, the event associated with the error will be returned only to the RS-232-C port.

### Port Independent Events

Informally, a port independent event is any event that cannot be classified as port dependent. Port independent events are always returned to both the RS-232-C and GPIB controllers. Formally, a port independent event is generated when any of the following system status conditions occur:

- Internal Error
- Internal Warning
- Power On
- Operation Complete
- User Request
- Calibration Due

Table of Errors, Warnings, and Messages

Message	Meaning
DIG plugin calibration failed	<b>Error.</b> The digitizer detected an internal error during plug-in calibration. Two consecutive failures indicate that the instrument should be referred to a qualified service person.
DIG probe compensation failed	<b>Error.</b> The digitizer detected an internal error during probe compensation. Two consecutive failures indicate that the instrument should be referred to a qualified service person.
Digitizer stopped—timebase settings exceed available acquisition memory	<b>Error.</b> A Digitizer setting was attempted that exceeded the bounds of a time base parameter. Try a less extreme value for the last attempted setting.
Distal out of range—limit set	<b>Warning.</b> A value was entered for the parameter that was outside the allowed range. The limit value nearer the entered value is used.
Dsy Intensity out of range—limit set	<b>Warning.</b> A value was entered for the parameter that was outside the allowed range. The limit value nearer the entered value is used.
Enhanced Accuracy available after ( <i>delay period</i> )	<b>Notice.</b> The ENHANCED ACCURACY button was pressed before the 20 minute power-up warmup period had elapsed. You will be prompted when the warmup is complete if the selfcal mode is manual and the configuration has changed.
Env out of range—limit set	<b>Warning.</b> A value was entered for the parameter that was outside the allowed range. The limit value nearer the entered value is used.
Events Holdoff out of range—limit set	<b>Warning.</b> A value was entered for the parameter that was outside the allowed range. The limit value nearer the entered value is used.
Expression too complex	<b>Error.</b> The entered vertical trace description either exceeded 55 characters or the instrument could not resolve its complexity.

**Table of Errors, Warnings, and Messages**

Message	Meaning
Front panel locked out	<b>Warning.</b> A front panel operation was attempted while the front panel was locked out. The lockout was due to instrument power up or calibration processes, or to an explicit external interface (i.e., GPIB or RS-232-C) command.
Function not available in selected plugin range	<b>Error.</b> Probe Calibration was attempted when a differential amplifier's input gain was restricted from 0.1V/div to 10V/div. In this restricted range, probe calibration cannot be performed.
General DIG failure detected (code number)	<b>Error.</b> An internal error was detected in the Digitizer. No other error was suitable. Refer the instrument to a qualified service person.
GPIB Address out of range— limit set	<b>Warning.</b> A value was entered for the parameter that was outside the allowed range. The limit value nearer the entered value is used.
Hardcopy aborted	<b>Warning.</b> The HARDCOPY button was pushed a second time while the screen was still "frozen." This aborts the requested hardcopy.
Hardcopy absent or off line	<b>Error.</b> The HARDCOPY button was pushed while the printer was off line or disconnected. No copy is made.
Hardcopy complete	<b>Notice.</b> The requested hardcopy is complete.
Horz Mag out of range—limit set	<b>Warning.</b> A value was entered for the parameter that was outside the allowed range. The limit value nearer the entered value is used.
Horiz Pos Gr out of range— limit set	<b>Warning.</b> A value was entered for the parameter (graphic position) that was outside the allowed range. The limit value nearer the entered value is used.
Illegal DATE/TIME	<b>Error.</b> An illegal date or time value was specified.



Table of Errors, Warnings, and Messages

Message	Meaning
Input channel ( <i>number</i> ) overdrive on ( <i>compartment</i> ) plugin	<b>Warning.</b> The signal to the specified plug-in unit channel was being clipped (distorted).
Input channel ( <i>number</i> ) overload on ( <i>compartment</i> ) plugin	<b>Warning.</b> The signal to the specified plug-in unit channel was overloading the input termination resistor. Input impedance of the channel is changed to protect the resistor.
Internal DAC overflow on channel ( <i>number</i> ) of ( <i>compartment</i> ) plugin	<b>Error.</b> The last attempted plug-in control operation (e.g., setting offset) caused a plug-in DAC (digital/analog converter) to exceed its allowed range. Calibration may be the problem, so push the ENHANCED ACCURACY button. After a successful selfcal, reattempt the control operation. If the error still occurs, refer the problem to a qualified service person.
Invalid number input	<b>Error.</b> Numerical input was beyond the range of the floating point processor.
Invalid smooth argument	<b>Error.</b> A value was entered for the smooth waveform function that was outside the allowed range. The vertical description is discarded and no new waveform is displayed.
Left Limit out of range—limit set	<b>Warning.</b> A value was entered for the parameter that was outside the allowed range. The valid range value nearer the entered value is used.
Left plugin channel(s) used differently in main and window sources	<b>Error.</b> The Window Holdoff mode was set to events or time, and Main and Window trigger sources included different channels from the same plug-in unit. This results in chopped trigger sources, which are not allowed.
Left plugin communications failure	<b>Error.</b> The mainframe was unable to communicate with the compartment. Likely causes are a hardware failure or removal of the plug-in unit with instrument power on.

Table of Errors, Warnings, and Messages

Message	Meaning
Main Pos out of range—limit set	<b>Warning.</b> A value was entered for the parameter that was outside the allowed range. The limit value nearer the entered value is used.
Main Size out of range—limit set	<b>Warning.</b> A value was entered for the parameter that was outside the allowed range. The limit value nearer the entered value is used.
Main Record Len out of range—limit set	<b>Warning.</b> A value was entered for the parameter (record length) that was outside the allowed range. The limit value nearer the entered value is used.
Mesial out of range—limit set	<b>Warning.</b> A value was entered for the parameter that was outside the allowed range. The limit value nearer the entered value is used.
Misuse of AVG/ENV function	<b>Error.</b> Average or Envelope was invoked on a purely stored or scalar displayed waveform. These functions can be used only on waveforms that include an actively acquired channel.
No active acquisitions—digitizer remains stopped	<b>Warning.</b> An attempt was made to start the digitizer with no active acquisitions. Scalar and stored waveforms are not actively acquired.
No further XY waveforms may be defined	<b>Error.</b> An attempt was made to display more than the allowed number of XY waveforms. Only one live XY waveform or two stored or scalar XY waveforms can be displayed at one time.
No more waveforms permitted	<b>Error.</b> A plug-in channel or probe ID button was pressed to add another waveform to the display when eight waveforms were already displayed. Up to eight waveforms can be displayed at a time.

Table of Errors, Warnings, and Messages

Message	Meaning
No signal detected—AUTOSET terminated	<b>Error.</b> Either the target signal has no ac component or no plug-in units are installed. Autoset tries to display the ac component of a signal. Set the ON/STANDBY switch to STANDBY before installing or removing plug-in units.
Nonvolatile RAM completely reset	<b>Warning.</b> At power up, a failure of the battery backup power for the non-volatile RAM was detected. When a battery failure occurs, the instrument initializes the RAM with factory default settings.
Nonvolatile RAM front panel settings lost; instrument ID data retained	<b>Warning.</b> At power up, the instrument detected corrupted data in the stored front panel settings. The stored settings are replaced with the factory default setting. Nonvolatile RAM is not initialized as it is when the backup battery fails. A bad transfer of front panel settings over an ASCII interface is a probable cause.
Out of memory	<b>Error.</b> A function was attempted when there was a lack of either Executive or Waveform memory space. Removing one or more previously stored waveforms will free Executive and Waveform memory. Shortening the record lengths of acquired waveforms will free Waveform memory.
Panzoom may not be disabled	<b>Error.</b> An attempt was made to turn Pan/Zoom off with a scalar or stored waveform selected.
Panzoom may not be enabled	<b>Error.</b> An attempt was made to enable Pan/Zoom with a Window waveform selected.

Table of Errors, Warnings, and Messages

Message	Meaning
Percent Fill out of range—limit set	<b>Warning.</b> A value was entered for the parameter that was outside the allowed range. The limit value nearer the entered value is used.
Perform probe compensation procedure—touch menu entry	<b>Prompt.</b> Probe calibration and deskewing was successfully completed. The probe should be manually adjusted for proper compensation.
Point Accumulate and XY waveforms are mutually exclusive	<b>Error.</b> An attempt was made to simultaneously display an XY waveform and a Point Accumulate waveform.
Powerup new configuration partial calibration occurring	<b>Notice.</b> One or more plug-in units that were not previously calibrated in this instrument were installed before power up. These plug-in units must be calibrated in this instrument before the system can operate in Enhanced Accuracy state.
Press ENHANCED ACCURACY again to confirm request	<b>Prompt.</b> After pressing the ENHANCED ACCURACY button once under valid conditions, a confirming push of the button is requested to activate the self calibration function.
Probe calibration error	<b>Error.</b> Calibration of the selected probe failed. The probe is not calibrated.
Proximal out of range—limit set	<b>Warning.</b> A value was entered for the parameter that was outside the allowed range. The limit value nearer the entered value is used.
Request for external service ignored	<b>Warning.</b> Your touch of the RQS icon was ignored by the external controller. Touch the icon again to signal the controller.
Right Limit out of range—limit set	<b>Warning.</b> A value was entered for the parameter that was outside the allowed range. The valid range value nearer the entered value is used.

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