Setting Jitter/Wander Parameters

This section gives examples of how to work with Jitter/Wander test setups; Setting Jitter or Wander Generation; Setting Jitter Receive Parameters; and, Calibrating Jitter Systems.

Refer also to the **Telecommunications Technology** section within the *Appendices* (located on reference   on   CD) for theory of operation information on Jitter & Wander.

CTS850 SDH/PDH Test Set

Jitter/Wander   Working with Test Setups

You can use the CTS850 to run the following types of jitter conformance tests:

H   Jitter Tolerance

H   Jitter Transfer

H   Output Jitter

H   Pointer Jitter (SDH rates only)

In each of these tests, the CTS850 measures the jitter on a signal at the output of a network element. For some tests, the CTS850 generates jitter to stimulate the network or a network element while it simultaneously measures the network response.
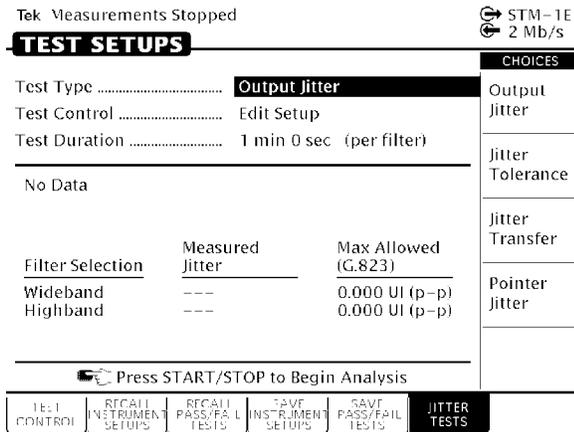
Figure 3 65: Example of TEST SETUP, Jitter & Wander screen

Before selecting a jitter test, set the specific jitter generation and measurement rates and payloads required by the test. For example, to perform an output jitter test on an STM 1 signal, set the receive line rate to STM 1 before selecting test setups.

It is not necessary to set the jitter and wander TRANSMIT or RECEIVE settings, since this is done automatically by the CTS850 software, depnding on the test type.

When the test is complete, you can save the results, print the results, or export the results data to bring into a spreadsheet. Refer to "Saving and Recalling Setups" later in this section for more information.

Setting Up a Jitter Test

To set up a jitter test:

1. If the jitter test requires the test set to measure jitter, use the RECEIVE menu to set the receive parameters that are appropriate for the signal you will be measuring. Refer to *Setting SDH Receive Parameters* for information about this topic.

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2. If the jitter test requires the CTS850 to generate jitter, use the TRANSMIT menu to set the transmit parameters that are appropriate for the signal you will be generating. Refer to *Setting SDH Transmit Parameters* for information about this topic.

3. To set the type of jitter test:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	JITTER TESTS	Test Type	Output Jitter
			Jitter Tolerance
			Jitter Transfer
			Pointer Jitter

H Select **Output Jitter** to measure the jitter at the output of a network element. (The output jitter test does not use the CTS850 jitter-generation capability.)

H Select **Jitter Tolerance** to measure the tolerance of the input of a network element to applied jitter (this test uses bit error measurement).

H Select **Jitter Transfer** to measure the transfer of jitter from the input to the output of a network element.

H Select **Pointer Jitter** to measure jitter in PDH signals due to pointer movement in the SDH signal (this test does not use jitter generation).

The remaining parameters are dependent on the type of jitter test you select.

Jitter Tolerance Test. Follow these additional steps to set up a jitter tolerance test.

1. Set the Test Type to Jitter Tolerance and set the mask type as appropriate. The available masks depend on the rate, as shown in the table below.

Rate	Available Masks
2 Mbit/s	G.823 (Standard), G.823 (National)
34 Mbit/s	G.823
45 Mbit/s *	G.824
140 Mbit/s	G.823
STM 0	GR 253
STM 1	G.825, G.958 (Type A), G.958 (Type B)
STM 4	G.825, G.958 (Type A), G.958 (Type B)

* If your CTS 850 test set supports the 45 Mb/s option.

The CTS850 modulates the transmitted line or clock frequency with sinusoidal jitter. The jitter generator begins at the start frequency and stops at the end frequency.

2. To set the start frequency for the jitter generator:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	JITTER TESTS	Start Frequency	*as appropriate*

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3. The available end frequencies are dependent on the current transmit rate. To set the end frequency for the jitter generator:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	JITTER TESTS	End Frequency	*as appropriate*

4. The CTS850 can generate jitter at intermediate frequencies between the start frequency and end frequency. To set the total number of frequencies generated (including the start and end frequencies):

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	JITTER TESTS	Number Freq Samples	*as appropriate* *

* Number of samples change depending on Start/End frequencies.

5. To set the tolerance criteria:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	JITTER TESTS	Tolerance Criteria	Onset of Errors
			BER Penalty

H Select **Onset of Errors** to define the tolerance as two Errored Seconds in a 30-second time interval.

H Select **BER Penalty** to measure the amount of jitter that is equivalent to a 1 dB loss of signal power at the input of the network element (optical only).

6. If you selected Onset of Errors, skip to step 12. If you selected BER Penalty, continue with step 7 (see the following figure).
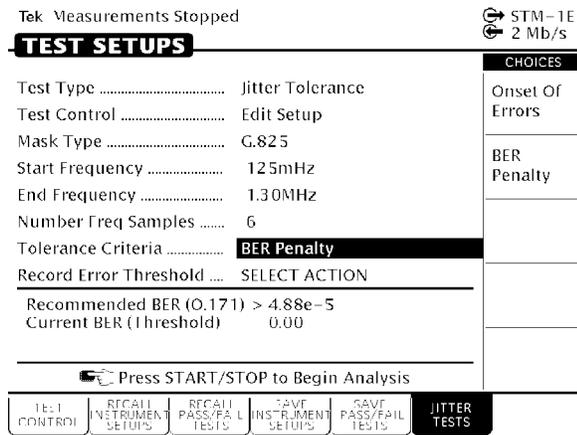

Figure 3-66: Example of TEST SETUP, Jitter Tests, BER Method

7. The CTS850 must be connected to a network element through an optical attenuator.

8. To set a baseline bit-error rate for the measurement:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	JITTER TESTS	Record Error Threshold	Measure BER

9. Observe the Current BER and Recommended BER values in the display. Increase the optical attenuation until the Current BER reaches or exceeds the Recommended BER.

10. When the Current BER equals the Recommended BER to within an order of magnitude:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	JITTER TESTS	Record Error Threshold	Record BER

11. Increase the receive level by 1.0 dB (that is, reduce the attenuation by 1.0 dB).

12. Press the **START/STOP** button to run the jitter test. The results are displayed on screen in numerical and graphical form. This takes about 6 minutes for 6 points.

Transfer Jitter Test. Follow these additional steps to set up a jitter transfer test.

1. Set Test Type to Jitter Transfer. Set the mask type as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	JITTER TESTS	Mask Type	*as appropriate*

The available mask types are dependent on the current transmit rate. The CTS850 modulates the transmitted line with sinusoidal jitter. If the TX menu sets Jitter Output to Clock, the Jitter Transfer screen will indicate "Unsupported Settings". The jitter generator begins at the start frequency and stops at the end frequency.

2. The available start frequencies are dependant on the current transmit rate. To set the start frequency for the jitter generator:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	JITTER TESTS	Start Frequency	*as appropriate*

3. The available end frequencies are dependent on the current transmit rate. To set the end frequency for the jitter generator:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	JITTER TESTS	End Frequency	*as appropriate*

4. The CTS850 can generate jitter at intermediate frequencies between the start frequency and end frequency. To set the total number of frequencies generated (including the start and end frequencies):

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	JITTER TESTS	Number Freq Samples	*as appropriate* *

* Points dependent on Start/End frequencies.

NOTE. You can calibrate a 0 dB baseline, as described in ITU T O.171, prior to measuring transfer jitter if the folllowing conditions are met: the jitter generation output and measurement input are both set to line, and if the transmit and receive rates are set to the same rate. If either of the conditions can not be met, skip to step 10.

5. Verify that the jitter generation output and measurement input are both set to Line.

6. Verify that the transmit and receive rates are set to the same rate.

7. To calibrate a 0 dB baseline:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	JITTER TESTS	Action	Calibrate

8. Press the **START/STOP** button to run the 0 dB baseline calibration routine. This takes about 3 minutes.

9. To run the transfer jitter test after the calibration is complete, press Edit Setup:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	JITTER TESTS	Action	Jitter Transfer

10. Press the START/STOP button to run the jitter transfer test. The results are displayed on screen in numerical and graphical form. This takes abouts 4 minutes for 7 samples. Press View Data to see the data and whether or not the test passed. Press Edit Setup to return to Main Jitter Test menu.

Output Jitter Test. Follow these steps to set up an output jitter test.

1. Set Test Type to Output Jitter. The recommended time duration for an output jitter test is one minute. To set the test duration to one minute (or any other duration of your choice),:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	JITTER TESTS	Test Duration	15 sec, 30 sec
			1 min, 15 min
			USER DEFINED

 H Select **USER DEFINED** to enter a time other than one of the preset choices. The maximum duration is 99 days, 23 hours, 59 minutes, 59 seconds.

2. Press the **START/STOP** button once or twice, light should be lit to run the jitter test. The results are displayed on screen in numerical form. After the test duration time has passed for each filter (wideband and highband), compare measured jitter with the maximum allowed to determine pass or fail. The resolution of these measurements are 0.001 UIpp.

Pointer Jitter Test. Follow these additional steps to set up a pointer jitter test. To select Pointer Jitter, the TX must be set to a SDH rate, and the RX set to a PDH rate.

1. Set Test Type to Pointer Jitter. To set the pointer sequence type:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	JITTER TESTS	Sequence Type	*as appropriate*

2. Press the **START/STOP** button to run the jitter test. The results are displayed on screen in numerical form, after about 6 minutes.

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Saving and Recalling Results

You can save one jitter test result to disk and recall that one test result for later display and analysis. If you want to save test results permanently, you must save the test results to a disk.

The CTS850 saves each type of jitter test result with a unique file-name extension. Because of the unique extensions, you can perform different types of jitter tests on a network element and give them a common results file name.

To save jitter test results:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	JITTER TESTS	Test Control	Save Results

Refer to *Saving and Recalling Results* for detailed information about using the disk drive to save and recall results.

Printing Results

You can print jitter test results using the "Print Last Screen" choice in the Print Control dialog box. Refer to *Printing Results* for detailed information about printing.

Exporting Results into a Document

You can export the jitter tolerance and jitter transfer test results in a Microsoft Excel compatible format to produce a graph for your documentation. Use the saved files with .XTL or .XTR for this purpose.

The file format consists of a header that identifies the type of test, the date and time, the transmit source, the transmit and receive rates, and the number of sample points in the graph. Data following the header is comma separated and consists of four values for each sample point in the graph: modulation frequency, mask amplitude, measured amplitude, and a status indicator that indicates an over range condition.

Setting Jitter or Wander Generation

To test the response of a network to jitter, you may need to generate SDH signals, PDH signals, or clock signals that contain jitter. You can use the CTS850 to generate any of these signals with a controlled amount of jitter. This jitter is a sinusoidal modulation of the line rate or clock rate; you can specify the frequency and amplitude of the jitter.

Wander generation selection is identical to jitter generation except that it applies for modulation frequencies of 10 Hz or less. See the following figure.
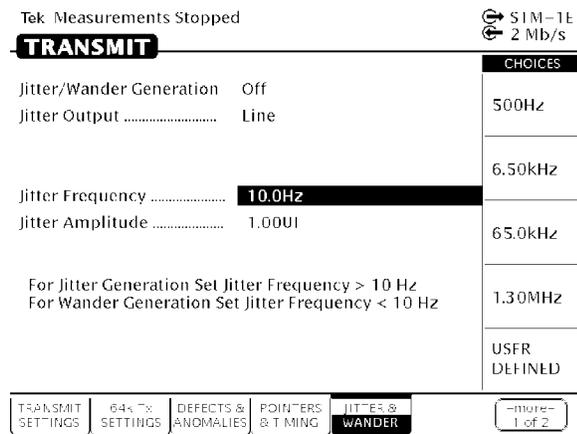

Figure 3 67: Example of TRANSMIT, Jitter menu

NOTE. The jitter compliance tests, available through the JITTER TESTS page of the TEST SETUPS menu, automatically set the jitter generation parameters needed for the test. When you use the jitter compliance tests, you do not need to set the controls described below.

Periodic calibration of the jitter generation system is recommended to maintain best accuracy. You can execute a built in calibration routine before making critical measurements. Refer to the Jitter Calibration *information located at the end of the this section.*

Turning on Jitter or Wander Generation

To turn on jitter or wander generation:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	JITTER & WANDER	Jitter/Wander Generation	Off
			On

H   Select **Off** to disable jitter/wander generation.

H   Select **On** to enable jitter/wander generation.

Selecting the Jitter Output

To select the signal that you want to apply generated jitter to:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	JITTER & WANDER	Jitter Output	Line
			Clock 0.8 V
			2 MHz G.703

H Select **Line** to enable generated jitter on the transmitted line (SDH signal or PDH signal) that comes out of the front panel. This will also generate jitter on the rear-panel Jitter Clock Output, even though it may not be in use. Note: for 140 Mbit/s and STM 1E, line mode rear panel signal is twice the line rate.

H Select **Clock 0.8 V** to enable generated jitter on the rear-panel jitter clock output (J/CLK OUT) only (AC-coupled ECL). The transmitted line remains jitter free.

H Select **2 MHz G.703** to enable generated jitter on the rear-panel jitter clock output (J/CLK OUT) that meets the interface requirements for synchronization signals as specified in G.703. The transmitted SDH or PDH line signal remains jitter free.

You can independently set the Jitter Clock Output rate and frequency offset, regardless of the line rate and frequency offset of the transmitted signal. To set an independent rate for the Jitter Clock Output:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	JITTER & WANDER	Jitter Output	Clock 0.8V
		Jitter Clock Rate	*as appropriate*

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To set an independent frequency offset for the Jitter Clock Output:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	JITTER & WANDER	Jitter Output	Clock 0.8V
		Jitter Clock Offset	*as appropriate*

Setting the Jitter Frequency and Amplitude

The generated jitter is a sinusoidal modulation of the nominal line or clock rate. Refer to the *Modulation Range* specifications for details about jitter/wander generation capability. To set the modulation frequency:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	JITTER & WANDER	Jitter Frequency	*as appropriate*

H Select **USER DEFINED** to specify a jitter frequency different from the predefined choices. Use these choices: Course   to adjust most significant digit or change decade scale; Medium   to adjust second digit; Fine   to adjust third digit.

NOTE. To generate jitter, set the Jitter Frequency to 10 Hz or greater. To generate wander, set the Jitter Frequency to less than 10 Hz.

To set the modulation amplitude (in unit intervals):

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	JITTER & WANDER	Jitter Amplitude	300.00 UI (Max) 150.00 UI (Max/2) 0.0 UI

H   Select **USER DEFINED** to specify a jitter amplitude different from the predefined choices. Use choices Coarse, Medium or Fine.

Measure Wander on a 2 MHz clock output from a network element

When generating wander, synchronize the test system to an external timing source. This can be done by connecting a 2.048 MHz clck to the rear panel reference timing input and selecting timing source under TRANSMIT settings. Follow the steps below:

H   Connect 2 MHz reference clock to 2 Mbps/ 2 MHz reference clock input on Rear Panel of test unit.

H   Connect External 2 MHz clock to be measured to Jitter/ Clock input on Rear Panel of test unit.

H   Go to TRANSMIT settings. Set the Transmit Clock to 2 MHz external. The Receive Clock is the Same. No Wander Measurements should be made with Internal Clock.

H   Press Start/Stop twice to Start/Restart the test.

H   For RESULTS, select the Jitter & Wander Screen, and view Wander Measurements.

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Setting Jitter Receive Parameters

You can set the CTS850 to measure jitter or wander on incoming SDH signals, PDH signals, or clock signals. First, set the jitter receive parameters below. Then, you can view jitter or wander measurement results in the Jitter & Wander Results page shown at the end of this section on Jitter.
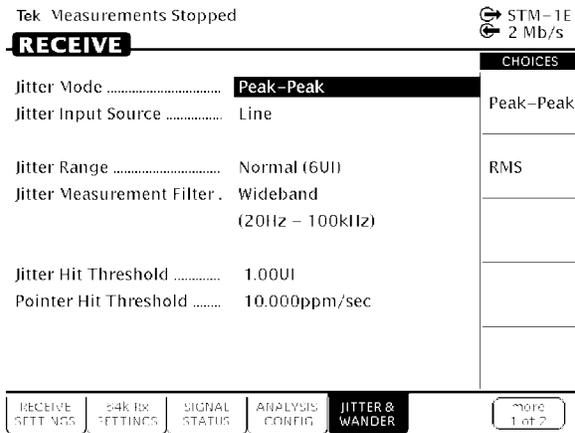

Figure 3 68: RECEIVE, Setting Jitter Mode, Peak to Peak

NOTE. The jitter compliance tests, available through the JITTER TESTS page of the TEST SETUPS menu, automatically set the jitter receive parameters needed for the test. When you use the jitter compliance tests, you do not need to set the controls described below.

Periodic calibration of the jitter generation system is recommended to maintain best accuracy. You can execute a built in calibration routine before making critical measurements. Refer to the Jitter Calibration *information located at the end of this section.*

Selecting the Jitter Mode

To select the jitter measurement mode:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
RECEIVE	JITTER & WANDER	Jitter Mode	Peak-Peak
			RMS

H   Select **Peak-Peak** to make peak-to-peak jitter measurements.

H   Select **RMS** to make RMS jitter measurements. If you select RMS, the only available input filter is a 12 kHz high-pass filter.

Selecting the Input Source

To select the input source on which you want to measure jitter:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
RECEIVE	JITTER & WANDER	Jitter Input Source	Line
			Clock

H   Select **Line** to measure jitter in the received line (front-panel SDH or PDH signal) selected in the RECEIVE SETTINGS page.

H   Select **Clock** to measure jitter on the rear-panel external jitter clock input (J/CLK IN). If you select Clock, you must set the external jitter clock input rate; that rate does not have to be the same as the Receive Rate selected in the RECEIVE SETTINGS page.

Selecting the Jitter Range

The jitter range determines the maximum measureable jitter and the resolution of the measurement. To select the range:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
RECEIVE	JITTER & WANDER	Jitter Range	Normal
			Extended

H Select **Normal** to measure jitter up to 6 UI_{p-p} with a resolution of 0.005 UI (frequency dependent). Refer to RX Range Mask in Specifictions section (in Appendix).

H Select **Extended** to extend the jitter measurement range up to 200 UI_{p-p} (frequency dependent) with a resolution of 0.01 UI.

Selecting the Jitter Input Filter

You can choose from three types of jitter measurement high pass filters defined by ITU-T standards: wideband, highband, and fullband. The passbands for the filters, shown in Figure 3 69, are dependent on the signal or clock rate settings; the 3 dB frequencies are described in the *Specifications* located in the Appendices at the back of this book.

The ITU T standard that applies to jitter input filters is contained in G.823, Table 1, Measurement Filter Bandwidth.
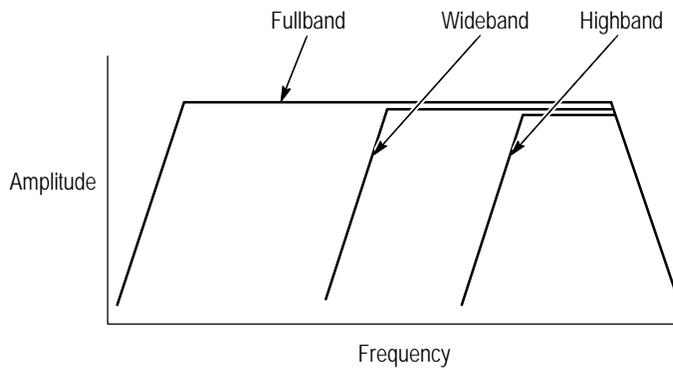
Figure 3 69: Jitter High Pass Filters

To select the jitter input filter:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
RECEIVE	JITTER & WANDER	Jitter Measurement Filter	Wideband
			Highband
			Fullband

H   Select **Wideband** to measure jitter using the wideband measurement filter (500 Hz   1.3 MHz).

H   Select **Highband** to measure jitter using the highband measurement filter (65 kHz   1.3 MHz).

H   Select **Fullband** to measure jitter over the wideband range plus very low frequency jitter that may affect timing quality for Video, PBX and GSM systems that derive an internal reference from the supplied line signal (10 Hz   1.3 MHz).

NOTE. Separate Highband National and Highband Standard settings are available for the 2 Mb/s rate, as referenced in the ITU T standards.

If you select the Fullband jitter input filter, perform the following steps to set the filter high-pass frequency:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
RECEIVE	JITTER & WANDER	Fullband High-pass	0.1 Hz
			1 Hz
			10 Hz

Note that the lock time for 1 Hz and 10Hz settings are longer than other filter settings.

Setting the Jitter Hit Threshold

The jitter hit threshold determines the sensitivity of the Jitter Hit Seconds measurement, which is based on peak-to-peak jitter.

Jitter Hit Seconds is a count of how many seconds the threshold was exceeded since the beginning of the the measurement. Measurement will normally begin between 2 5 seconds after the start button on the front panel is pressed. You can set the threshold to any value between 0 and 200 UI, depending on the Range Setting.

Whenever the received jitter exceeds the range of the jitter measurement system, the Current Jitter reads Unlocked. Jitter Unlocked Seconds is a count of how many seconds the measurement system has been unlocked since the beginning of the the measurement.

To set the jitter hit threshold:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
RECEIVE	JITTER & WANDER	Jitter Hit Threshold	*as appropriate*

H   Select **USER DEFINED** to specify a jitter hit threshold different from the predefined choices.

Setting the Pointer Hit Threshold

The pointer event threshold (available for PDH rates) determines the sensitivity of the Jitter Pointer Hits measurement, which is based on the frequency drift rate. To set the pointer event threshold:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
RECEIVE	JITTER & WANDER	Pointer Hit Threshold	*as appropriate*

H   Select **USER DEFINED** to specify a pointer hit threshold different from the predefined choices. You can set the threshold to any value between 0 and 10 ppm/sec.

Example of Jitter Measurements
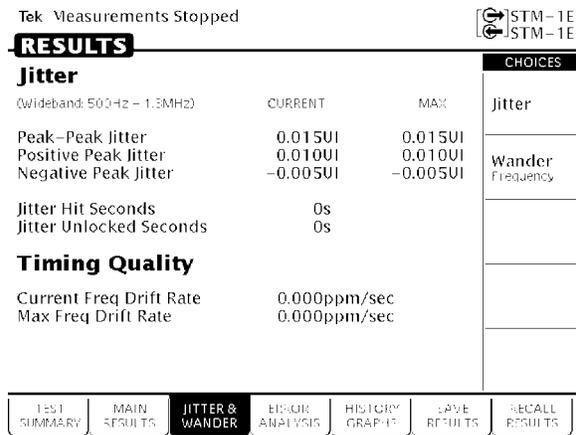
The RESULTS screen for Jitter/ Timing Quality follows.

Figure 3   70: RESULTS, Jitter and Timing Quality

Example of Wander Measurements

The "max" value shows the maximum peak to peak, positive peak, and negative peak since the beginning of the measurement.

When measuring wander, it is necessary to synchronize the test to an external timing source. This can be done by connecting a 2.048 MHz clock signal to the rear panel timing input and selecting the appropriate timing source under the TRANSMIT settings.
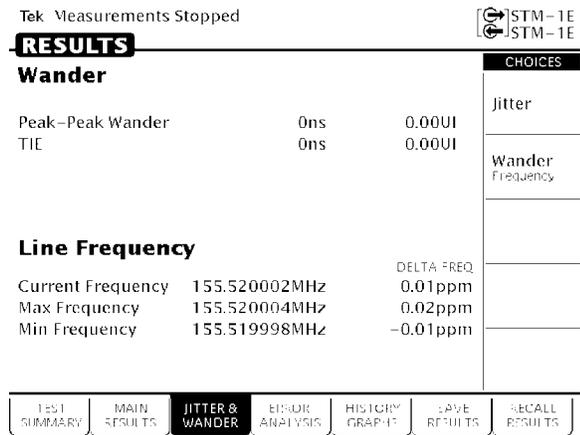
The RESULTS screen for Wander/ Line Frequency follows.

Figure 3 71: RESULTS, Wander and Line Frequency

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Calibrating Jitter Systems

Periodic calibration of the jitter generation and measurement systems is recommended to maintain best accuracy. You can execute built in Jitter Measurement calibration routines before making critical measurements.

Run Jitter Measurement before runing Jitter Generation Calibration. This Jitter Measurement calibration takes about 15 minutes for all rates. You can calibrate one particular rate by selecting the appropriate calibration routine.

If your CTS 850 test set supports a 45 Mb/s rate, this screen below will show that rate in addition to all the others displayed.
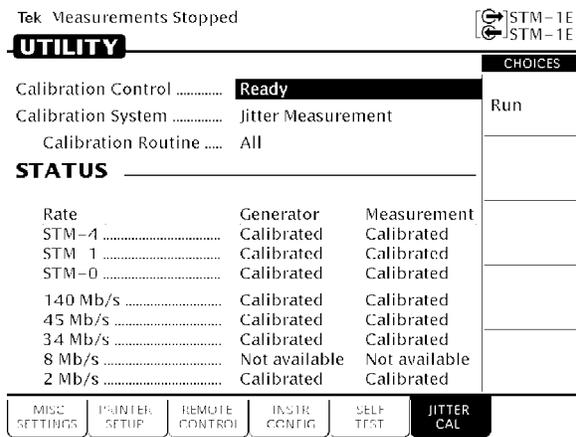

Figure 3 72: Example of UTILITY, Jitter Calibration

Executing Jitter Calibration

To calibrate the jitter measurement system:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
UTILITY	CALIBRATION	System	Jitter Measurement
		Routine	All
		Calibration Control	Run

To calibrate the jitter generation system:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
UTILITY	CALIBRATION	System	Jitter Generation
		Routine	All STM 0 STM 1 STM 4 2 Mb/s 34 Mb/s 45 Mb/s 140 Mb/s Analog output
		Calibration Control	Run

Jitter Generation for all rates takes about 45 minutes to run.

A status message indicates that the calibration is running, has completed and has passed, or has failed.

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