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User Manual

Tektronix

CTS 850
Test Set
SDH/PDH, Jitter & Wander

070-9988-01

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General Safety Summary

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

Only qualified personnel should perform service procedures.

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

CTS 850 SDH/PDH Test Set

Injury Precautions

Use Proper Power Cord

To avoid fire hazard, use only the power cord specified for this product.

Avoid Electric Overload

To avoid electric shock or fire hazard, do not apply a voltage to a terminal that is outside the range specified for that terminal.

Ground the Product

This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

Do Not Operate Without Covers

To avoid electric shock or fire hazard, do not operate this product with covers or panels removed.

Use Proper Fuse

To avoid fire hazard, use only the fuse type and rating specified for this product.

Do Not Operate in Wet/Damp Conditions

To avoid electric shock, do not operate this product in wet or damp conditions.

Do Not Operate in Explosive Atmosphere

To avoid injury or fire hazard, do not operate this product in an explosive atmosphere.

Wear Eye Protection

To avoid eye injury, wear eye protection if there is a possibility of exposure to high-intensity rays.

Product Damage Precautions

Use Proper Power Source

Do not operate this product from a power source that applies more than the voltage specified.

Provide Proper Ventilation

To prevent product overheating, provide proper ventilation.

Do Not Operate With Suspected Failures

If you suspect there is damage to this product, have it inspected by qualified service personnel.

Safety Terms and Symbols

Terms in This Manual

These terms may appear in this manual:

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

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

Terms on the Product

These terms may appear on the product:

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

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

CAUTION indicates a hazard to property including the product.

Symbols on the Product

The following symbols may appear on the product:



DANGER
High Voltage



Protective Ground
(Earth) Terminal



ATTENTION
Refer to
Manual



Double
Insulated

Certifications and Compliances

CSA Certified Power Cords

CSA Certification includes the products and power cords appropriate for use in the North America power network. All other power cords supplied are approved for the country of use.

Preface

This manual describes how to use the Tektronix CTS850 SDH/PDH Test Set. This paper–based manual, along with an accompanying user manual on CD–ROM, is your primary source of information about how the CTS850 SDH/PDH Test Set functions.

How This Manual is Organized

The CTS850 information is divided into four sections: *Getting Started, Operating Basics, Reference,* and *Appendices.*

Getting Started provides an overview of the CTS850 and describes first time operation. Both the paper–based user manual and the reference manual–on–CD contain this information.

Operating Basics explains the basic principles of operating the CTS850. The *Operating Basics* section also includes a tutorial which introduces you to most of the capabilities of the CTS850 test set. Both the paper–based user manual and the reference manual–on–CD contain this information.

Reference provides explanations of how to perform detailed tasks. The paper–based manual includes information on Basic Test Procedures and a detailed look at Jitter/Wander Testing. All other *Reference* information is contained in the reference manual–on–CD.

The *Appendices* provide a listing of specifications, default factory settings, an incoming inspection test, a section on telecommunications technology, a listing of relevant ITU–T standards, and other useful information. All *Appendices* information is contained on the reference manual–on–CD only.

Conventions

This manual uses the following conventions:

The names of front-panel controls and menus appear in all upper case letters, for example, TRANSMIT and HELP.

Names appear in the same case in this manual as they appear on the display of the CTS850, for example, Test Duration and USER DEFINED.

Within a procedure, a specific button to be pressed or a parameter to be selected appears in boldface print. For example, press the **AUTOSCAN** button or select **Continuous**.

The *Tutorial* and the *Reference* sections frequently present procedures in tables. Perform the procedure by reading from left to right in the table (see example below). The word *none* in a cell indicates that no action is required.

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
Begin with Step 1	Step 2	Step 3	Step 4
		Step 5	Step 6
		Step 7	Step 8, CTS850 instruction is complete

Some procedures require several iterations of highlighting parameters and selecting choices. Some procedures may require more than one menu button or menu page selection as well.

Related Manuals

The following documents are also available for CTS850 SDH/PDH Test Set:

The CTS850 SDH/PDH *Reference Manual on CD* (Tektronix part number 063–3013–01) contains all the user manual information, in a portable electronic document format.

The CTS850 SDH/PDH Test Set *Programmer Manual* (Tektronix part number 070-9990–XX) describes how to control the CTS850 using an instrument controller.

Wander Analyst User Manual (Tektronix part number 071–0518–XX) and Wander Analyst 6.0 PC software (Tektronix part number 063–3196–XX) for TDEV/MTIE analyis. This PC application software is bundled with Option 14– Jitter/Wander.

The *CTS850 SDH/PDH Test Set Service Manual* (Tektronix part number 070-9991-XX) provides information on maintaining and servicing your instrument to the module level.

Contacting Tektronix

Product Support	For application-oriented questions about a Tektronix measurement product, call toll free in North America: 1-800-TEK-WIDE (1-800-835-9433 ext. 2400) 6:00 a.m. – 5:00 p.m. Pacific time Or contact us by e-mail: tm_app_supp@tek.com For product support outside of North America, contact your local Tektronix distributor or sales office.
Service Support	Contact your local Tektronix distributor or sales office. Or visit our web site for a listing of worldwide service locations. http://www.tek.com
For other information	In North America: 1-800-TEK-WIDE (1-800-835-9433) An operator will direct your call.
To write us	Tektronix, Inc. P.O. Box 1000 Wilsonville, OR 97070-1000

Getting Started

Getting Started

This section provides a description of the CTS850, a list of standard and optional accessories, and explains how to operate the CTS850 for the first time.

Product Description

The Tektronix CTS850 SDH/PDH Test Set is a rugged, portable test set designed for installing and maintaining telecommunications networks. The CTS850 is an SDH analyzer that combines bit error rate test capabilities with overhead testing, payload mapping, and demapping in one unit. The CTS850 features the following capabilities:

- STM-0E, STM-0, STM-1E, STM-1, STM-4, 2 Mb/s, 8 Mb/s, 34 Mb/s, and 140 Mb/s transmit and receive
- Optical interface available at 1310 nm and 1550 nm
- Bit Error Rate testing
- BER test of VC4–4c concatenated payloads at 622 Mbit/s
- 45 Mbit/s mapping and demapping into SDH (optional)
- BIP error monitoring and analysis
- 2, 8, 34 and 140 Mbit/s PDH multiplexing/demultiplexing (MUX/DEMUX) with N/Mx64 kbit/s testing
- Payload mapping and demapping
- Jitter generation and analysis
- Wander generation and measurement (Real–Time Wander Analyst PC application software for TDEV/MTIE)
- Unique timing quality measurement
- Pointer generation, including sequences and analysis
- Alarm generation and analysis

- TU error monitoring and analysis
- Performance monitoring per G.821, G.826, M.2100 and M.2101.1 on all layers simultaneously
- Automatic Protection Switching (APS) testing
- DCC and user channel access
- Programmable via IEEE 488.2 and RS-232

The CTS850 meets the needs of the craftsperson and the network engineer. The CTS850 meets the requirements of those working in network installation and maintenance by providing the capability to perform:

- Network integrity testing
- In-service performance monitoring
- Stimulus and response testing
- Stress testing
- Overhead testing
- Automated jitter conformance testing
- G.821, G.826, M.2100 and M.2101.1 performance measurement

Accessories

Some accessories are included with the CTS850 SDH/PDH Test Set. If you wish to purchase optional accessories or additional standard accessories, see a Tektronix products catalog or contact your local Tektronix field representative.

Standard Accessories

- CTS850 SDH/PDH Test Set *User Manual*, Tektronix part number 070-9988-XX
- CTS850 SDH/PDH Test Set *Reference Manual on CD–ROM*, Tektronix part number 063–3013–XX

- CTS 850 SDH/PDH Test Set *Programmer Manual*, Tektronix part number 070-9990-XX
- Instrument Front Cover, Tektronix part number 200-3232-XX
- 75 Ω loopback BNC cable, Tektronix part number 012-1338-XX
- Pouch (to hold printer, user manual, etc.) Tektronix part number 016-1266-XX

Optional Accessories

- *CTS 850 SDH Test Set Service Manual* (Tektronix part number 070-9991-XX)
- Electrical STS–0E/1E and STM–1 Plug–in (Standard)
- FC, SC or ST Optical Connectors
- 1.6/1.5 connectors for all 75 Ohm BNC front panel connectors
- 2,8,34, 140 Mbit/s, VC–12, TU–3 Add/Drop Test
- Universal European: 220 V, 50 Hz power cord
- UK: 240 V, 50 Hz power cord
- Australian: 240 V, 50 Hz power cord
- North American: 240 V, 60 Hz power cord
- Switzerland: 220 V, 50 Hz
- Hard Transit Case, Tektronix part number 016-1157-XX
- Soft Carrying Bag, Tektronix part number 016-1158-XX
- Optical Connector Kit, Tektronix part number 020-1885-XX

Navigation – CTS 850 Paper–based Manual & CD–ROM

The following table shows you where to quickly find the section that answers your particular test & measurement questions.

In order to get you going as fast as possible with the CTS 850 test set, the paper–based user manual focuses solely on Getting Started information.

Everything else appears in the reference manual on CD–ROM, including all information contained in the paper–based user manual.

Table 1–1: Where to Find Information in this User Manual

If you want to know how to:	Look in this part of the manual:
Use the basic functions of the test set, including – Controls, indicators, connectors; Elements of front panel display; Menu structure; Online help; Connecting signals; Selection and editing of choices; Disk drive operation	*Functional Overview,* Chapter 2 (paper–based and reference manual–on–CD)
Tutorial	*Tutorial,* Chapter 2
Setup and use the test set for network and equipment test applications, including – * Network continuity checking * Transmission signal quality testing * Fault tolerance testing * Performance monitoring * Jitter and wander testing * Video timing quality testing	*Basic Test Procedures,* Chapter 3 (paper–based and reference manual–on–CD)
Set TX (SDH, PDH) (reference manual–on–CD only)	
Set transmit rate; specify the AU under test; set the payload mapping and content; and set the overhead bytes for SDH signals	*Setting SDH Transmit Parameters,* Chapter 3
Set transmit rate, transmit clock, line clock offset, payload, framing, test pattern, active channel and background pattern for PDH signals	*Setting PDH Transmit Parameters,* Chapter 3

Table 1–1: Where to Find Information in this User Manual (Cont.)

If you want to know how to:	Look in this part of the manual:
Set RX (SDH, PDH) (reference manual–on–CD only)	
Set receive line rate; specify the AU under test; set payload mapping and content; check received optical signal power; view overhead bytes for SDH	*Setting SDH Receive Parameters,* Chapter 3
Set the receive rate, receive level, framing and test pattern for PDH signals	*Setting PDH Receive Parameters,* Chapter 3
Jitter/Wander – Set TX/RX, Work with Test Setups, Calibrate (paper–based and reference manual–on–CD)	*Setting Jitter/Wander Parameters,* Chapter 3
Set & Test Alarms, Errors, Pointers, Timing, APS (reference manual–on–CD only)	
Generate error conditions, set alarms, and simulate network failures	*Setting Alarms and Inserting Errors,* Chapter 3
Generate Automatic Protection Switching (APS) commands and view the network response	*Testing Automatic Protection Switching,* Chapter 3
Set the duration for a test, the resolution of test history, start and stop a test	*Setting Test Control Parameters,* Chapter 3
Save and recall instrument setups; Create and run pass/fail tests	*Working with Test Setups*, Chapter 3
Change date and time settings, printer settings, GPIB, RS–232 parameters. Run a self–test	*Changing Instrument Settings*, Chapter 3
View, Print, Save & Recall Measurements (reference manual–on–CD only)	
Monitor input signal for alarms, errors and failures, indicating current signal status, history of signal status	*Checking Signal Status*, Chapter 3
View, save, recall, and print test results	*Viewing Results*, Chapter 3

Table 1–1: Where to Find Information in this User Manual (Cont.)

If you want to know how to:	Look in this part of the manual:
Appendices (reference manual–on–CD only)	
Review available menu choices; Navigate menus	*Menu Maps*, Appendix A
Interpret Status & Error Messages	*Status & Error Messages*, Appendix B
Review Default Factory Settings	*Default Factory Settings*, Appendix C
Check all Specifications	*Specifications*, Appendix D
Verify the test set functions properly	*Incoming Inspection Test*, Appendix E
Check examples of instrument setups, test results and pass/fail tests that can be loaded into the test set	*Example Disk Contents*, Appendix F
Explain Rear–Panel Connectors	*Rear–Panel Connectors*, Appendix G
Change Optical Port Connectors	*Changing Optical Port Connectors*, Appendix H
Pack for Shipment	*Packing for Shipment*, Appendix I
Review telecommunications technology used by the test set	*Telecommunications Technology*, Appendix J
Look up word meanings in Glossary; review ITU–T standards used by the test set	*Glossary and ITU–T Standards*

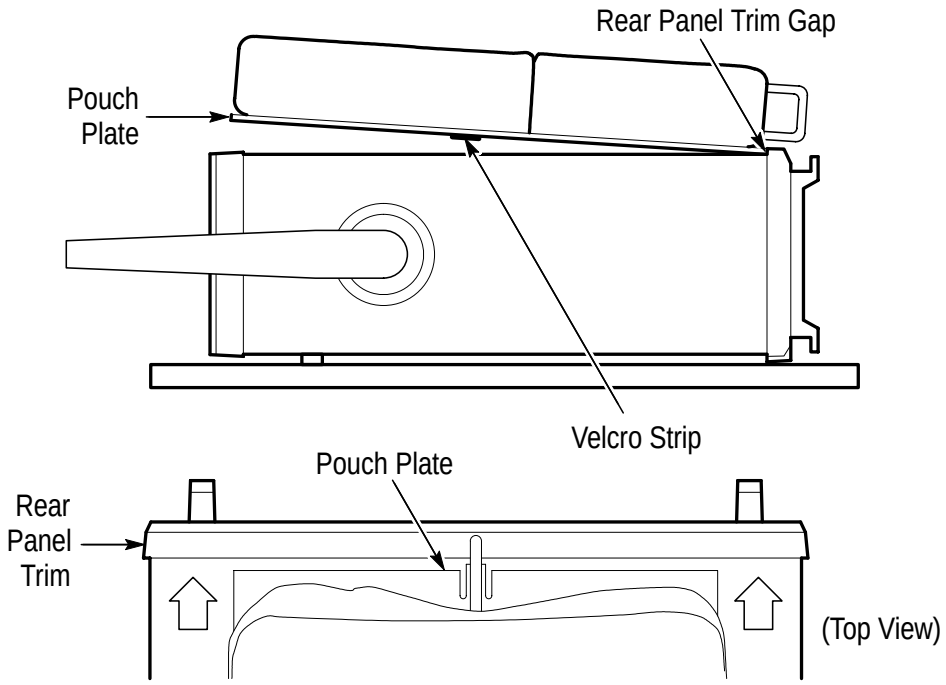
First Time Operation

This section describes how to set up the CTS850 for the first time.

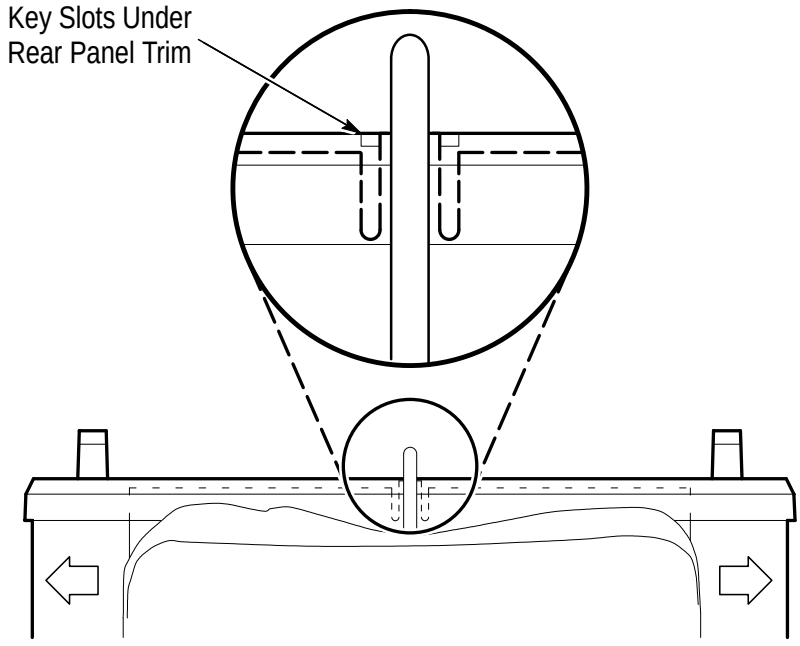
Installing the Accessory Pouch

The CTS850 ships with an accessory pouch that mounts on top of the instrument. The pouch is not installed at the factory. To install the accessory pouch:

1. Place the CTS850 on a table or work bench with the front facing toward you.
2. Center the pouch plate and insert the rear edge of the plate in the space between the cabinet top and the rear panel trim (see part A of Figure 1–1).
3. Move the pouch sideways as necessary to line up the key slots in the pouch plate with the keys on the rear panel (the plate is centered when it is aligned) and push the plate all the way in (see part B of Figure 1–1).
4. While keeping the pouch plate pushed under the rear panel trim, reach under the pouch plate and carefully remove the backing from the Velcro strip to expose the adhesive on the Velcro strip. The Velcro should remain attached to the pouch plate.
5. Grasp the pouch plate assembly with both hands near the front of the assembly.



A. Push the pouch plate into the rear panel trim gap.



B. Center the pouch plate to align with key slot under the rear panel trim.

Figure 1–1: Installing the Accessory Pouch

CAUTION. *In the next step, use only enough force to clear the front panel trim with the plate front edge. Excessive force will cause a permanent bow in the plate.*

6. Push back on the pouch plate and press down with the heels of your hands to bow the plate enough to slide the front of the plate into the space between the cabinet top and the front panel trim (see Figure 1–2).
7. Move the front of the pouch as needed to line up the slots in the plate with the keys on the front panel.
8. Release the pressure on the plate to allow it to return to its normal flat shape.
9. Press down firmly to secure the Velcro strip to the top of the cabinet top.

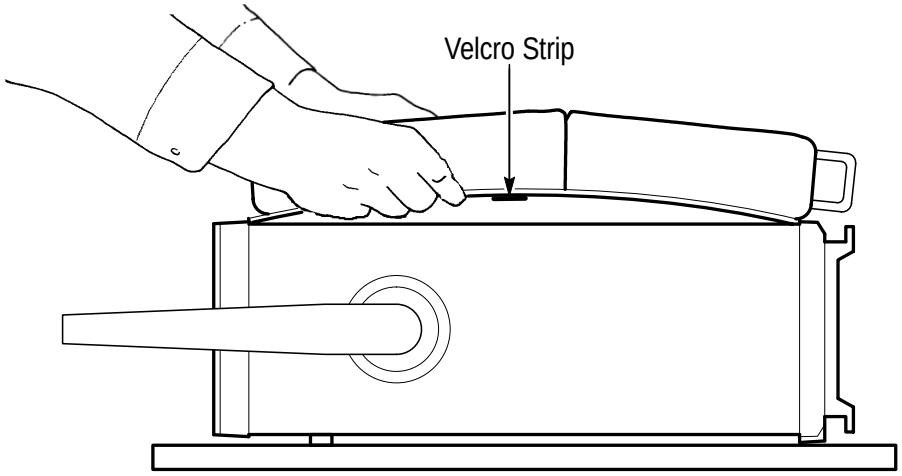


Figure 1–2: Inserting the Pouch Under the Front Panel Trim

CAUTION. *Do not use the D-ring (see Figure 1–3) on the pouch plate to lift the* CTS850*. Using the D-ring to lift the* CTS850 *can pull the accessory pouch off the* CTS850*, resulting in damage to the* CTS850.*The purpose of the D–ring is to provide extra support when the test set is placed in an upright position.*

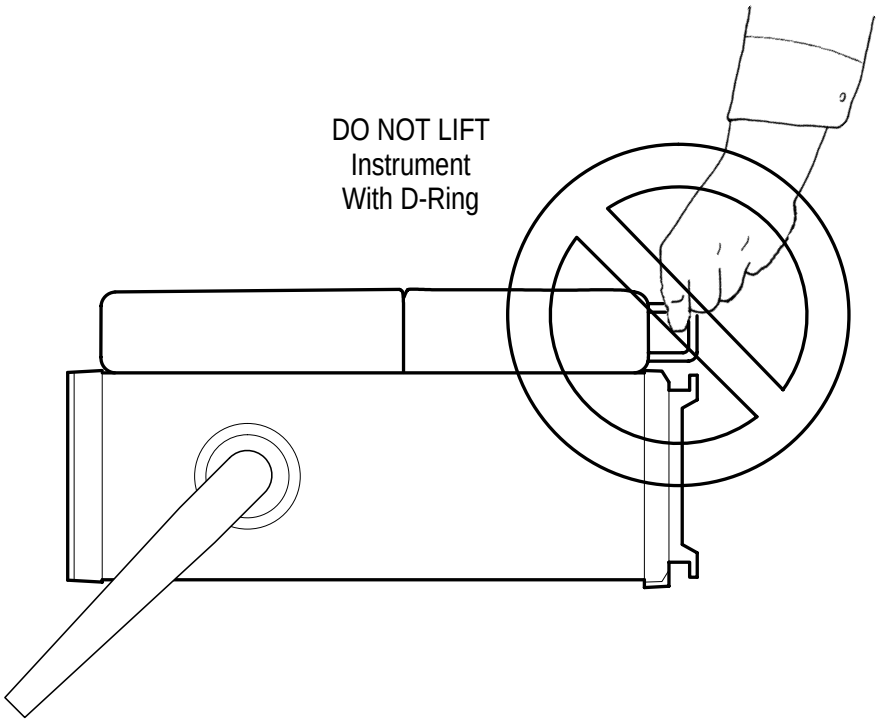


Figure 1–3: Location of the D-Ring on the Accessory Pouch

Setting Up the CTS850

Before you use the CTS850, ensure that it is properly set up and powered on.

To properly set up the CTS850, do the following:

1. Be sure that the environment in which you will operate the CTS850 is within instrument specifications. Specifications for temperature, relative humidity, altitude, vibrations, and emissions are included in the Appendix.
2. Leave space around the CTS850 for cooling. Verify that the air intake and exhaust holes on the sides of the cabinet (where the fan operates) are free of any airflow obstructions. Leave at least 5 cm (2 in) free on each side.



WARNING. *To avoid electrical shock, be sure that the power cord is disconnected before checking the fuse.*

3. Check the fuse to be sure it is the proper type and rating (see Figure 1–4). The CTS850 works with one of two fuses, depending on the AC supply. Each fuse requires its own cap (see Table 1–2). The CTS850 is shipped with the UL-approved fuse installed.

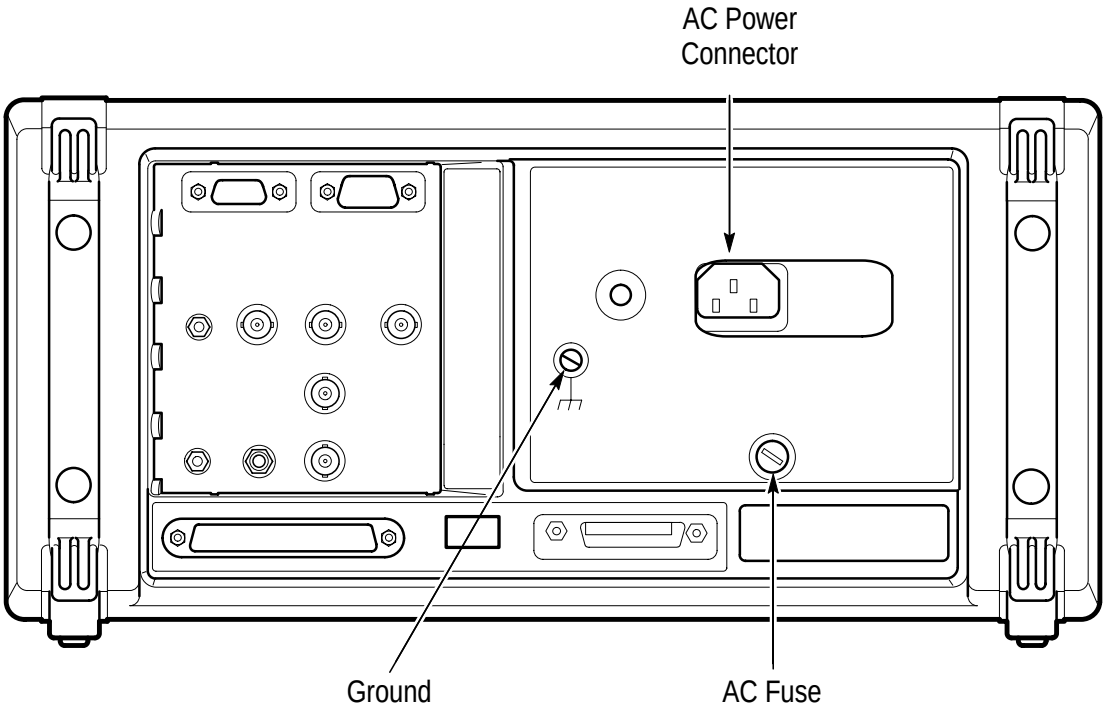


Figure 1–4: Rear-Panel Controls and Connectors Used in Setup

See page 2–4 in the next chapter for a labeling of what each rear panel connector is. See the appendix on Rear Panel Connections for a more comprehensive explanation of the rear panel connectors.

Table 1–2: Fuse and Fuse Cap Part Numbers

Fuse	Fuse Tektronix Part Number	Fuse Cap Tektronix Part Number
0.25 in × 1.25 in (UL 198.6, 3AG): 8 A FAST, 250 V	159-0046-XX	200-2264-XX
5 mm × 20 mm * (IEC 127): 6.3 A, 250 V	159-0381-XX	200-2265-XX

* If it is necessary to use the extra 5 mm x 20 mm fuse included in the fuseholder, the fuse cap must be removed.

4. Check that you have the proper electrical connections. The CTS850 power requirements are listed in Table 1–3.

Table 1–3: Power Requirements

Voltage Range	Frequency Range
90–132 V	50/60 Hz
180–250 V	50/60 Hz
100–132 V	400 Hz

5. Connect the proper power cord from the rear-panel power connector (see Figure 1–4) to the power system.

Turning On the CTS850

To properly turn on the CTS850:

1. Press the front panel **ON/STBY** button (see figure 1–5).

   The ON/STBY button controls power to all instrument circuits.

   The CTS 850 performs an internal self–test each time it is turned on. When turned on, it displays a screen that states whether or not it passed the self–test. (If the self–test passes, the status display screen is removed after a few seconds.)

2. Check the self–test results.

   If the self–test fails, contact your local Tektronix Service Center for assistance.

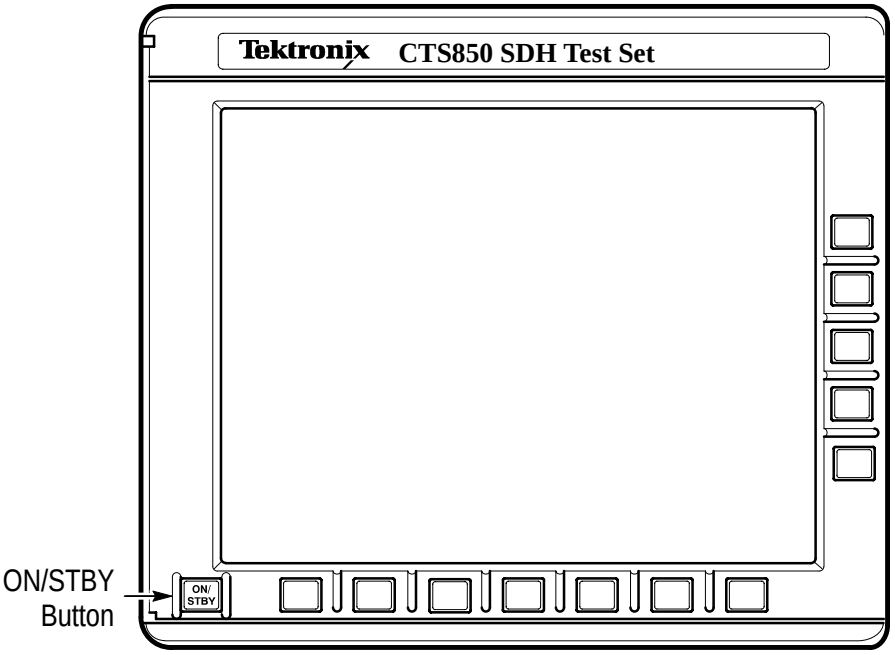


Figure 1–5: ON/STBY Button

Turning Off the CTS850

Press the **ON/STBY** button to turn off the CTS850.

Operating Basics

Functional Overview

This section describes how to use and navigate through the basic functions of the CTS850, including:

- Controls, indicators, and connectors
- Elements of the display
- Menu structure
- On-line help
- Connecting signals
- Parameter selection and editing
- Disk drive operation

This section also details conceptual information important to the use of the CTS 850, in particular:

- Difference between Synchronous, Plesiochronous, and Asynchronous
- PDH Hierarchy
- Definitions – Anomaly, Defect, Failure and Alarm
- SDH Multiplexing Principles
- Difference between Add/Drop, Map/Demap and Multplex/ Demultiplex
- 45 Mb/s Map/Demap Implementation

Front-Panel Controls, Indicators, and Connectors

Figures 2–1 and 2–2 identify the controls, indicators, and connectors located on the front panel of the CTS850 SDH/PDH Test Set.

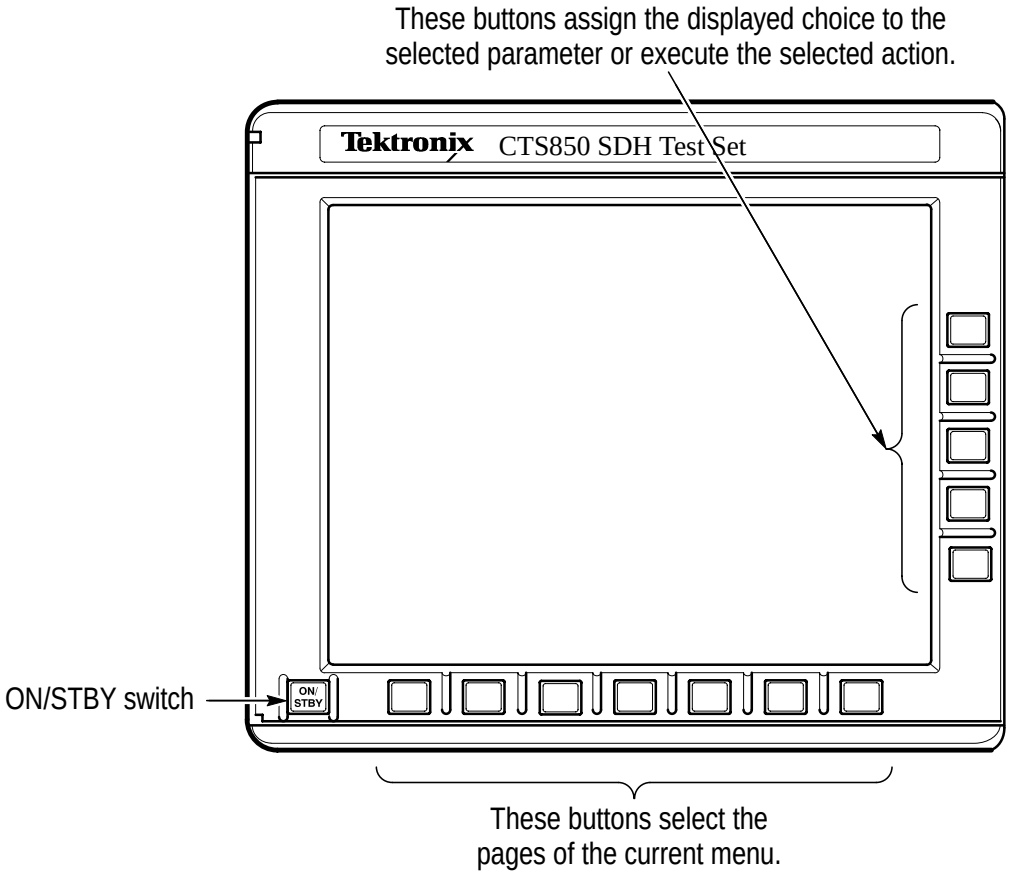


Figure 2–1: Controls Located Around the Display

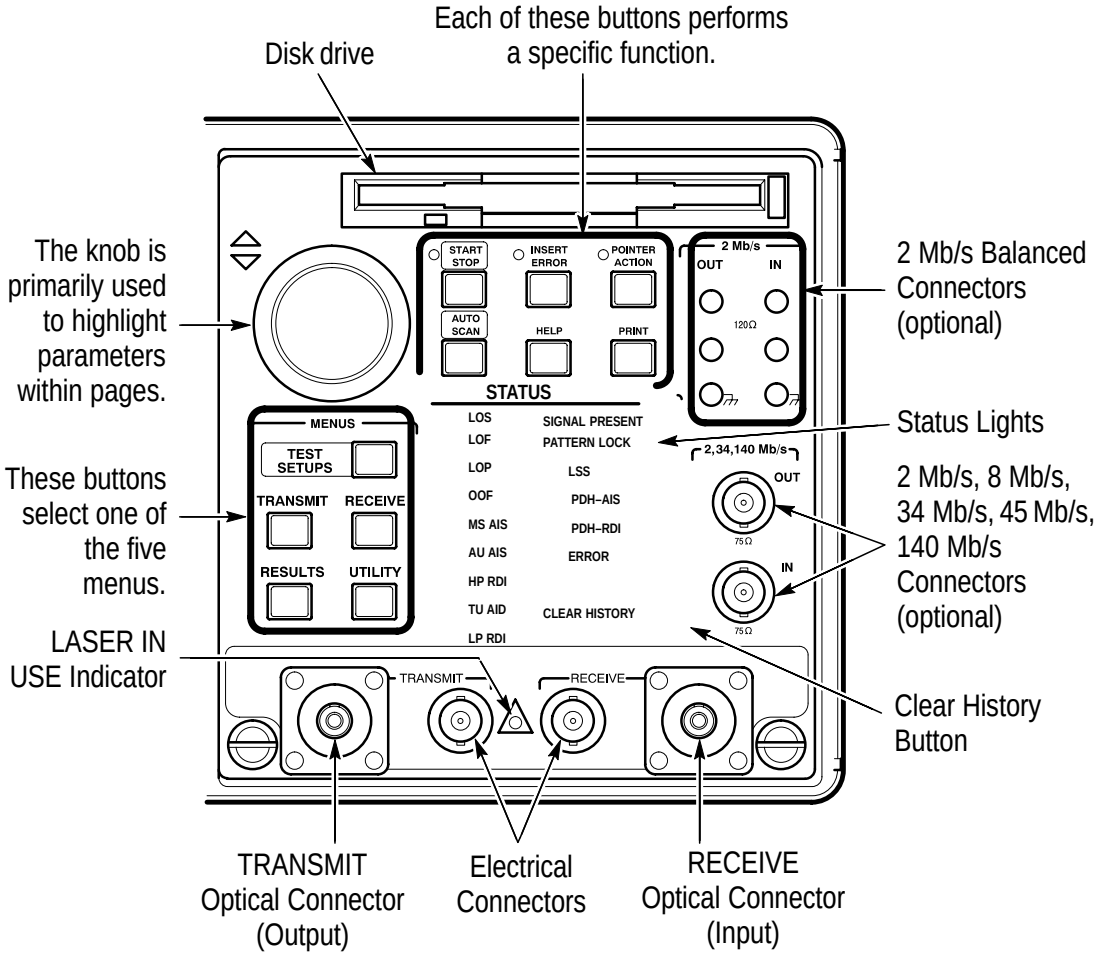


Figure 2–2: Front-Panel Controls, Indicators, and Connectors

Rear-Panel Controls and Connectors

See the appendix on Rear Panel Connections for a more comprehensive explanation of the rear panel connectors.

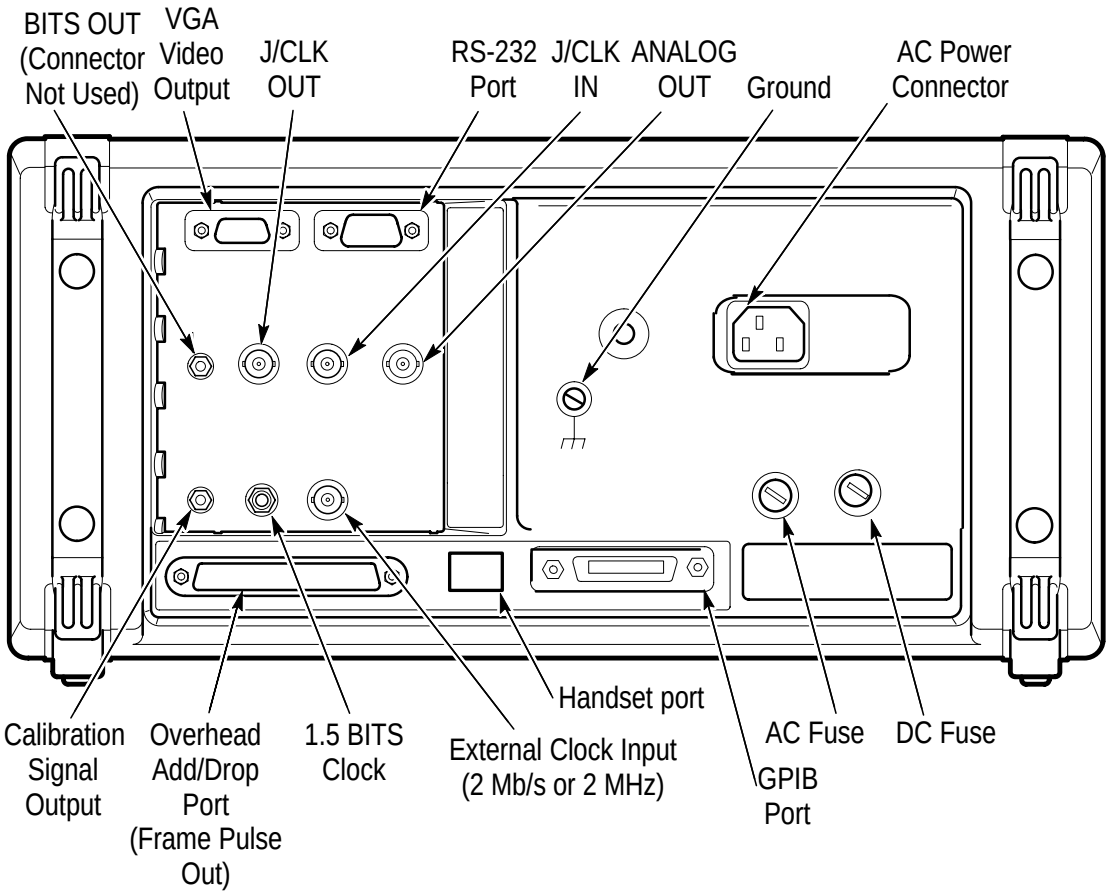


Figure 2–3: Rear-Panel Controls and Connectors

Front-Panel Status Lights

The status lights make it easy to quickly determine the condition of the received signal. There are three types of front-panel status lights.

- Green status lights. Green lights indicate whether a signal is present and whether the CTS850 has locked onto the signal.

- Red status lights. When a red status light is on, it means that the indicated event is occurring. When the red light is off, no event is occurring.
- Yellow history lights. Once an event has been detected, a yellow history light is turned on. The yellow history light shows that the associated event occurred at some time in the past. Yellow history lights remain on until you reset the event history by pressing the CLEAR HISTORY button, starting a new test, or changing the Receive Configuration settings (Receive Rate, Receive Pattern, etc.).

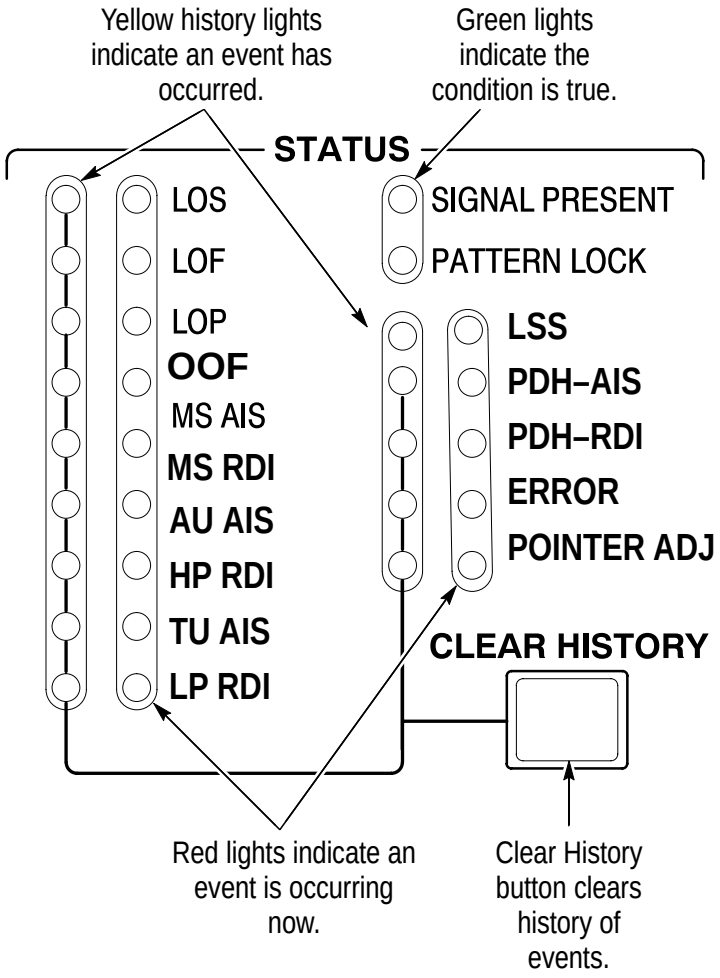


Figure 2–4: Status Lights

Reading the Display

There are several major areas that make up the CTS850 display (see Figure 2–5).

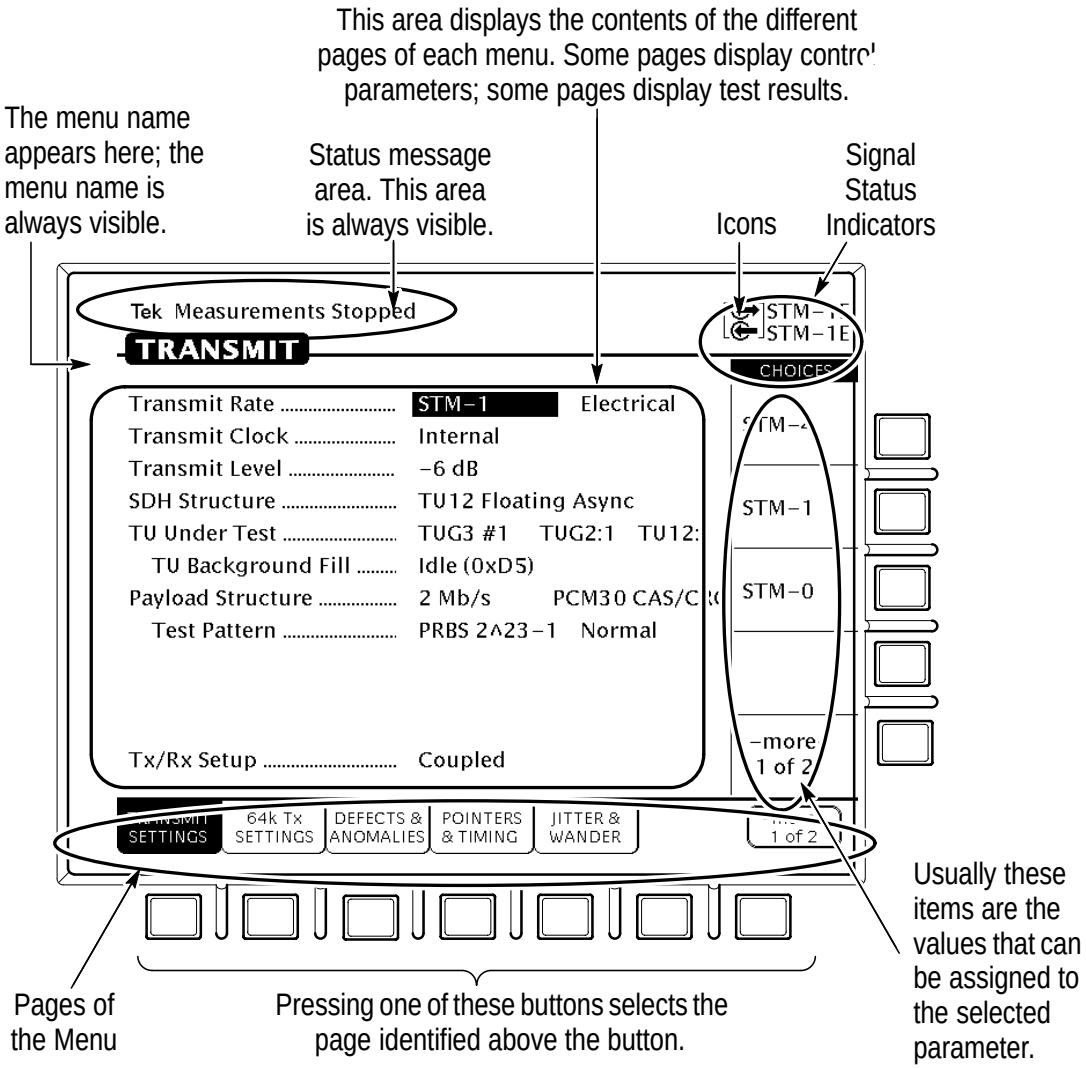


Figure 2–5: Major Areas of the Display

Figure 2–6 provides a guide to specific areas of the display.

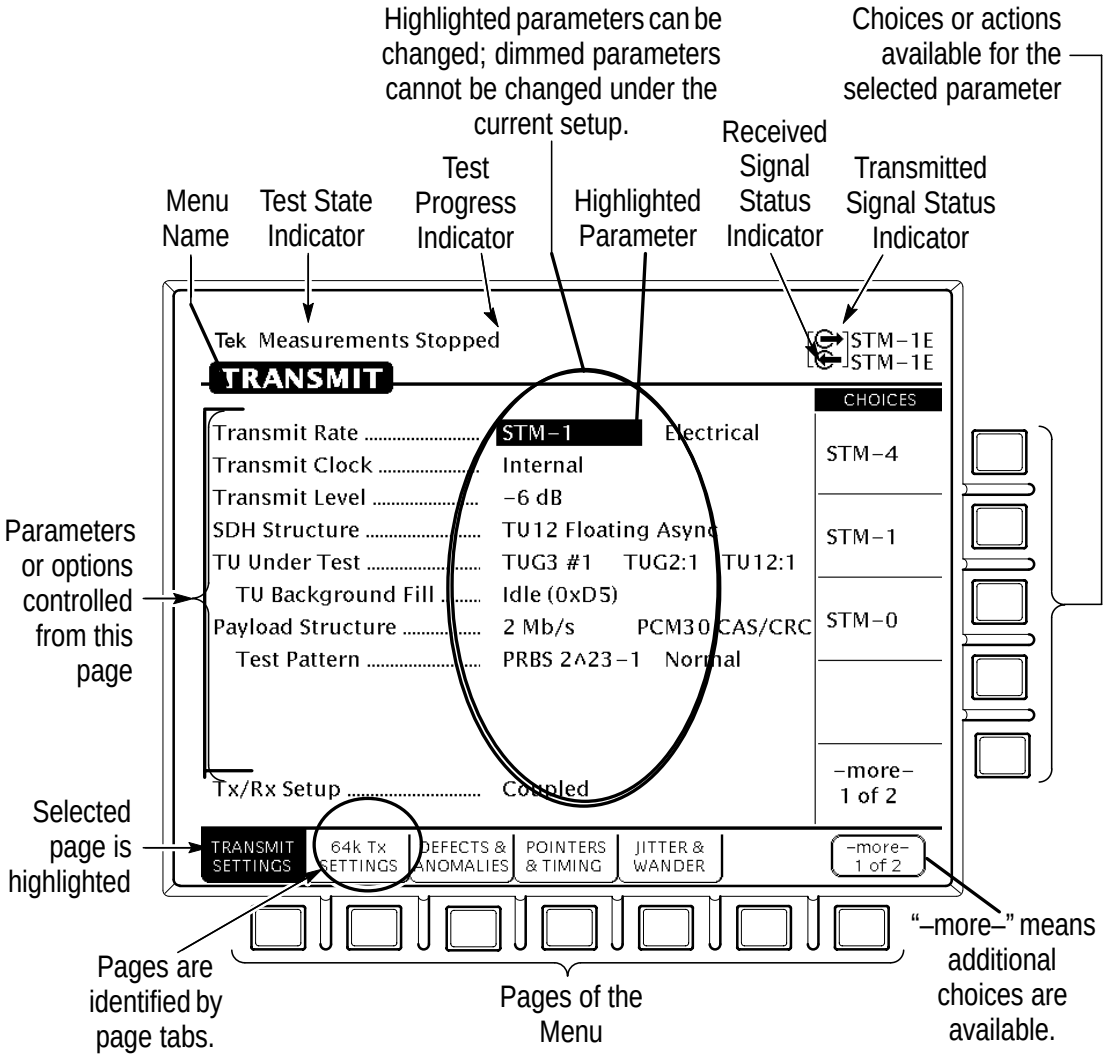


Figure 2–6: Specific Elements of the Display

Table 2–1 provides a list of icons that appear on the display. Icons are used to identify information, indicate instrument status, and clarify available actions.

Table 2–1: Icons that Appear in the Display

Icon	Meaning
	Transmitted signal
	Received signal
	CTS850 is in through mode
	CTS850 is in coupled mode
	Use the knob
	Not allowed
	File stored on disk
	File stored in memory
	Message or warning identifier
	Press the button to perform the indicated action
	The CTS850 is busy

The Basic Menu Structure

The CTS850 is controlled primarily through its menu system. Though several controls are located on the front panel, such as INSERT ERROR, most functions are controlled from one of the five menus. Figure 2–7 shows the five menus.

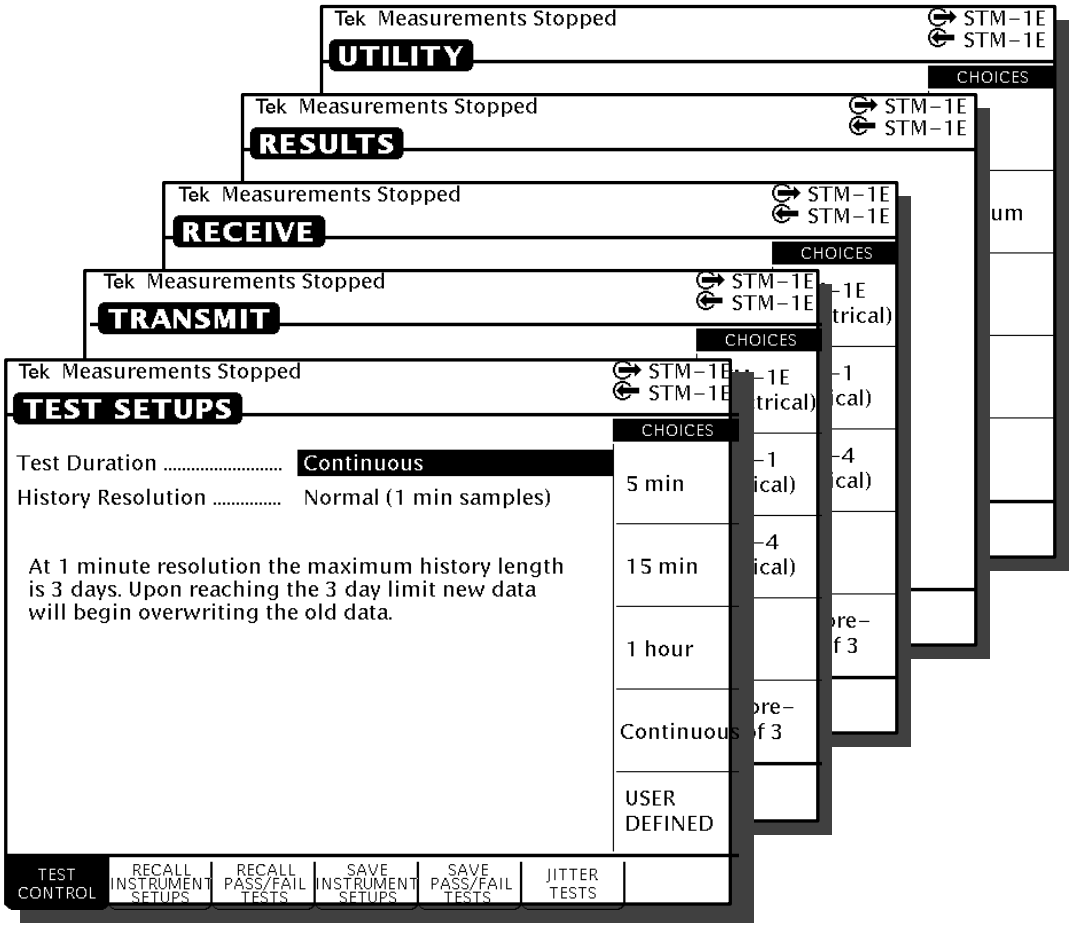


Figure 2–7: The Five Menus

What is a Menu?

A menu groups related functions together. For example, all settings that affect the signal transmitted by the CTS850 are located in the TRANSMIT menu. Each menu is made up of pages. A page is identified by a page tab located at the bottom of the display (see Figure 2–8).

If the choice is not available, it is not displayed or it is not highlighted.

The CTS850 always displays a menu. The name of the current menu is shown near the top of the display. To change to another menu, press a menu button on the front panel.

TEST SETUPS						
Test Control	Recall Instrument Settings	Recall Pass/Fail Tests	Save Instrument Setups	Save Pass/Fail Tests	Jitter Tests	
TRANSMIT						
Transmit Settings	64k Tx Settings	Defects & Anomalies	Pointers & Timing	Jitter & Wander	APS Commands	–More– 1 of 2
Transmit Settings	Section Overhead	Path Overhead	Trace Settings	Signal Labels	Overhead PRBS Test	–More– 2 of 2
RECEIVE						
Receive Settings	64k Rx Settings	Signal Status	Analysis Config	Jitter & Wander		–More– 1 of 2
Receive Settings	64k Rx Settings	Section Overhead	Path Overhead	RX CAS & Voice		–More– 2 of 2
RESULTS						
Test Summary	SDH Results	PDH Results	Jitter & Wander	Error Analysis	Perf Analysis	–More– 1 of 2
Test Summary	SDH Results	PDH Results	History Graphs	Save Results	Recall Results	–More– 2 of 2
UTILITY						
Misc. Settings	Printer Setup	Remote Control	Instr Config	Self Test	Jitter Cal	

Figure 2–8: Menus and Pages

NOTE. *The only time pressing a menu button does not change menus is when a dialog box is displayed or when you are entering a value for a parameter. You must first exit the dialog box or finish entering the value before you can change menus.*

A page usually provides control over a related group of instrument functions or parameters. For example, the TRANSMIT SETTINGS page in the TRANSMIT menu controls the rate, format, and active channels of the signal transmitted by the CTS850. However, some pages display information rather than provide control over settings; for example, the pages of the RESULTS menu display various test results.

Selecting Menus

To display a menu, press the button with the same on the front panel with the same name (see Figure 2–9).

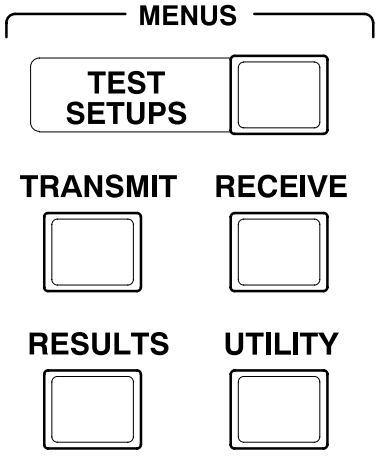


Figure 2–9: Menu Select Buttons

Selecting Pages

To select a page within a menu, press the button beneath the page tab located at the bottom of the display (see Figure 2–10).

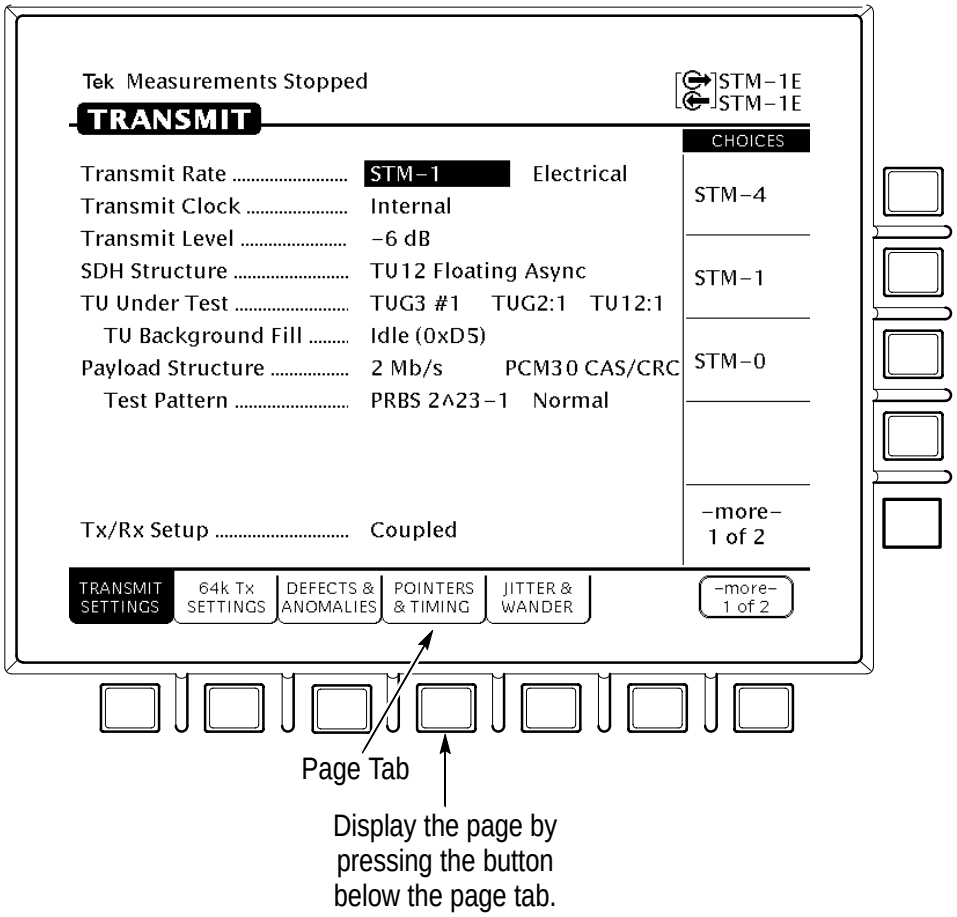


Figure 2–10: How to Display a Page

Displaying Help

To display help, press the **HELP** front-panel button.

When the HELP dialog box appears, use the knob to select the topic you wish to view (see Figure 2–11). After you select the topic to view, select **View Help** to see the help screen.

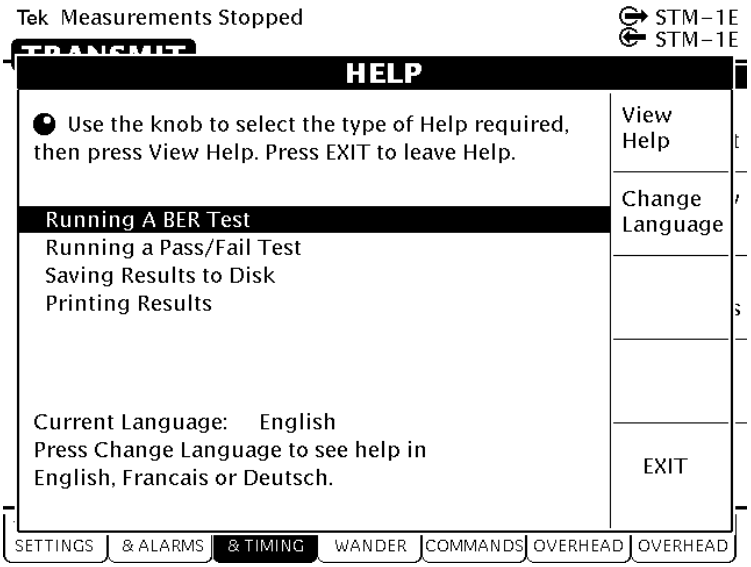


Figure 2–11: Help Dialog Box

Once you press View Help, the help screen for that topic is displayed. If a help topic covers more than one page, you can display the next page by selecting **Page Down**. To display the previous page, select **Page Up**.

To display help in a different language, select **Change Language**. Then, to display help in French, select **Francais**. To display help in German, select **Deutsch**. To display help in Spanish, select **Espanol**. To display help in Portuguese, select **Portugues.**

When you finish reading the help text, you can exit the help dialog box by selecting **EXIT**. If you wish to read additional help topics, select **Help Menu** to return to the main help screen.

Connecting Signals

To connect signals to the CTS850, use the electrical and optical connectors located at the bottom and right side of the front panel.

For optical connections, the CTS850 accepts both single mode and multimode fiber. For electrical connections, the CTS850 accepts 75 Ω coaxial cable with BNC connectors for SDH rates and 2 Mb/s Unbalanced, 8 Mb/s, 34 Mb/s, and 140 Mb/s rates. The CTS850 accepts Siemens connectors for 2 Mb/s Balanced signals.

Connecting Optical Signals

NOTE. *The optical TRANSMIT output is produced by a Class 1 laser device. The output from a Class 1 laser is safe to view without special eye protection. However, because other optical signals in your environment may exceed the Class 1 limits, we recommend eye protection as a precaution.*

NOTE. *When performing a loopback test with the CTS 850 and using the 1550 nm laser, always use 10 dB of attenuation. Always pad the input level to less than – 10 dBm.*

To connect optical signals to the CTS850:

1. Unscrew the dustcap that covers the optical port on the CTS850.
2. Remove the dustcap (if present) covering the connector on the optical fiber.
3. Carefully insert the transmit end of the optical fiber into the **RECEIVE** port on the CTS850. Line up the key on the optical fiber connector with the cutout on the optical port connector. Make sure that the optical fiber connector is fully inserted into the optical port.
4. Tighten the optical fiber connector so it does not accidentally come loose during use.

5. Carefully insert the receive end of the optical fiber into the **TRANSMIT** port on the CTS850 line up key. Make sure that the optical fiber connector is fully inserted into the optical port.
6. Tighten the optical fiber connector so it does not accidentally come loose during use. Tighten the connectors only finger tight; do not use a tool to tighten the connectors.



CAUTION. *To prevent damage to the optical port connectors and to keep them clean, always replace the dustcaps on the optical port connectors when not using the optical ports.*

Connecting SDH Electrical Signals

To connect SDH electrical signals to the CTS850:

1. Connect the transmit end of the cable to the **RECEIVE** connector on the CTS850.
2. Connect the receive end of the cable to the **TRANSMIT** connector on the CTS850.

Connecting PDH Electrical Signals

To connect electrical signals to the CTS850:

1. Connect the transmit end of the cable to the **IN** connector for the appropriate rate on the CTS850.
2. Connect the receive end of the cable to the **OUT** connector for the appropriate rate on the CTS850.

Initiating Autoscan

Autoscan is a feature that automatically scans the received signal and changes the CTS850 receive settings to match the received signal.

To initiate the autoscan feature, press the **AUTOSCAN** front-panel button. For detailed information on the AUTOSCAN function, see *Checking Signal Status* in Chapter 3– Reference. One limitation to be aware of is when the CTS 850 autoscans a TU. It is unable to directly recognize signals created by lower–rate PDH signals (but can in later Autoscan steps).

Changing Parameters

Most of the menu pages in the CTS850 contain parameters (or settings) that you can change. The choices available for a parameter appear in four ways (examples in parentheses):

- As a list (Test Pattern: PRBS 2^23–1, PRBS 2^20–1, ...)
- As a decimal number (Frequency Offset: 74.3 ppm)
- As a binary number (Z1 Byte: 10101111)
- As a text string (File Name: TEST_34)

Selecting Parameters

To change a parameter, use the knob to highlight it. As you turn the knob, the highlight moves from parameter to parameter (see Figure 2–12).

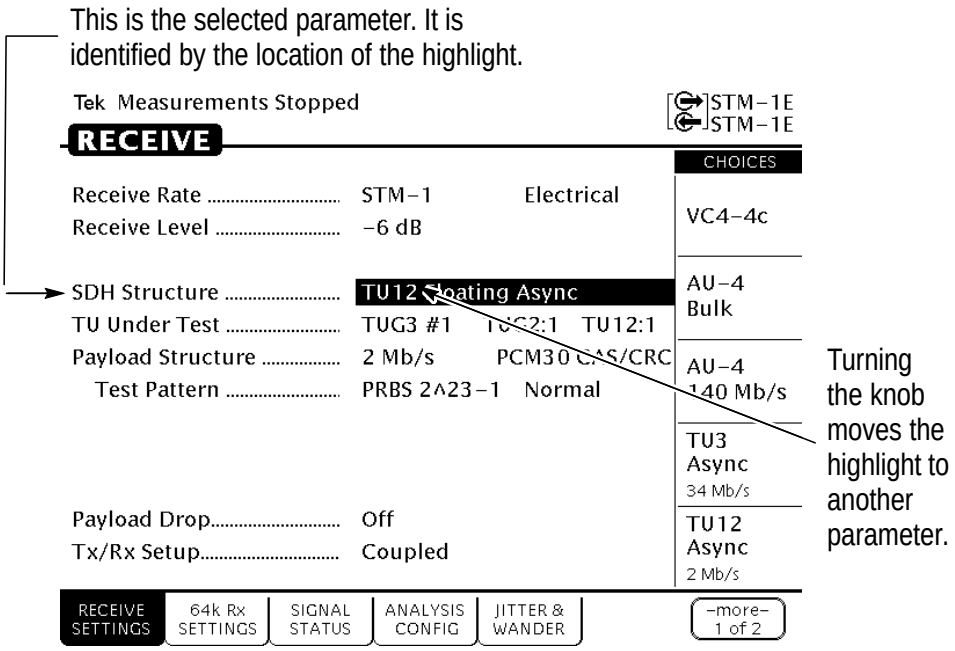


Figure 2–12: Selecting a Parameter

The parameter values displayed in high-intensity text indicate parameters that you can change. If a parameter is displayed in dimmed text, it cannot be selected under the current setup.

Selecting from Lists

Most parameters have a group of choices available. The choices are presented as a list, located along the right side of the display. Press the button next to the choice to assign that choice to the highlighted parameter.

Sometimes parameters have more than five choices available. When more than five choices are available, the bottom choice changes to –more–. Selecting **–more–** displays additional choices. Each time you press –more– the next list of choices is displayed. Below –more– is a line that shows which list of choices is displayed. When the last list of choices is displayed, pressing **–more–** displays the first list of choices again (see Figure 2–13).

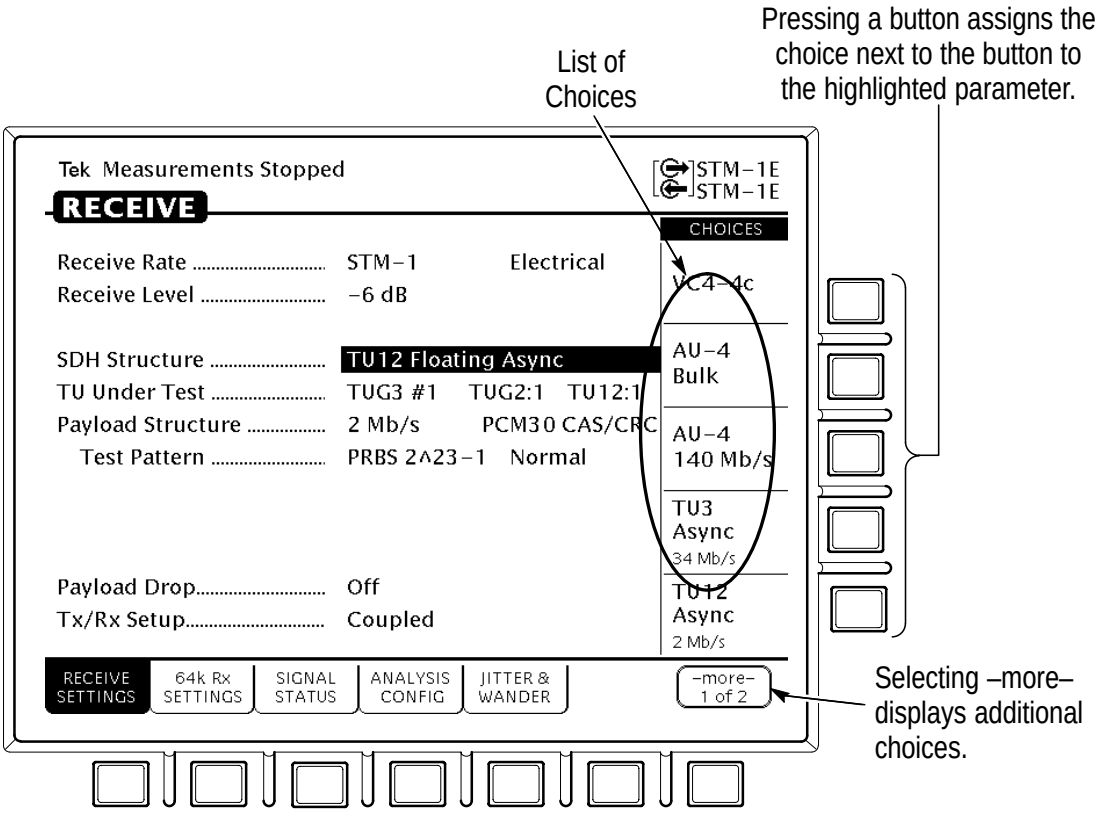


Figure 2–13: Selecting Choices From a List

Changing Decimal Numbers

Some parameters allow you to set a numeric value for them. For these parameters, preset choices are always provided to save you time. However, if the preset choices are not appropriate for your needs, you can set specific values by selecting the **USER DEFINED** choice (see Figure 2–14).

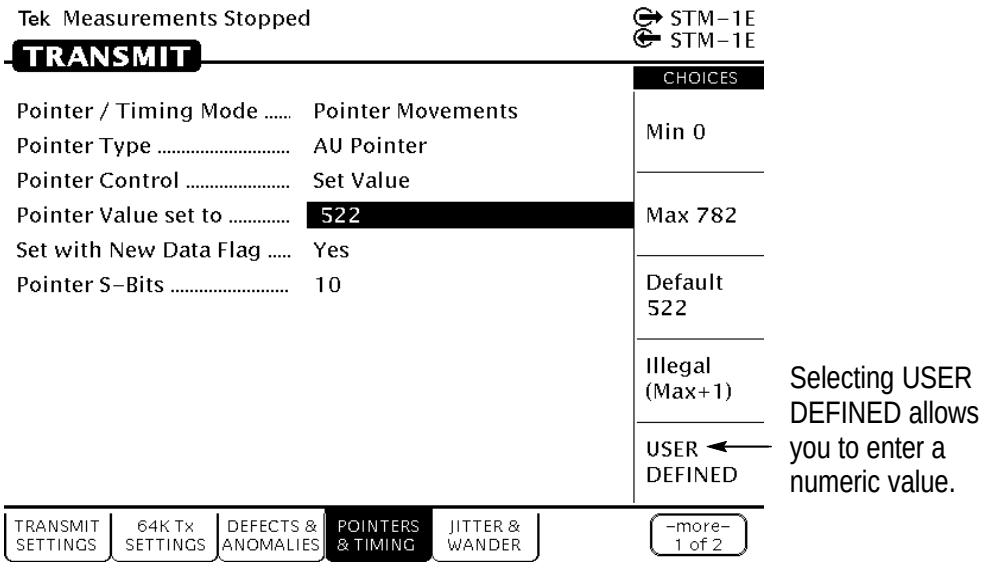


Figure 2–14: Selecting USER DEFINED

After you select USER DEFINED, the buttons at the right side of the display are reassigned, as shown in Figure 2–15.

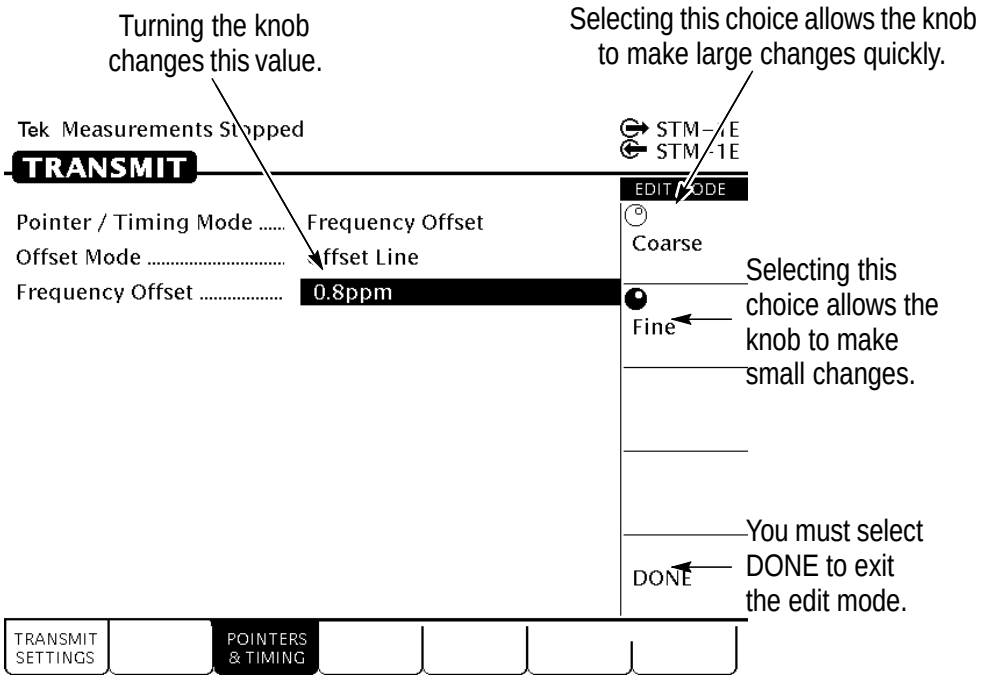


Figure 2–15: Entering a Numeric Value

After you press USER DEFINED, the CTS850 enters edit mode. In edit mode, you change the value of the highlighted parameter by turning the knob. When you have set the parameter to the desired value, select **DONE** to enter the value and exit edit mode.

***NOTE**. The new value does not take effect until DONE is selected.*

When in edit mode, the knob can work in several ways. As shown in Figure 2–15, the knob can be assigned to make either coarse or fine adjustments to the highlighted parameter. For other parameters, the knob is assigned to change different elements of the selected parameter. For example, when setting a test time, rather than making coarse or fine adjustments, the knob is assigned to change days, hours, minutes, or seconds.

The knob icon is displayed in solid form to indicate which function it is currently assigned to. The knob icon is displayed in outline form next to other possible choices.

Changing Binary Numbers

There are two kinds of binary numbers that can be changed in the CTS850: payload patterns and overhead bytes. As with other numerical values, you can select preset values or enter specific values by selecting Edit Byte.

To change a byte:

1. Highlight the byte with the knob (see Figure 2–16).
2. Change the byte by selecting one of the preset choices at the right side of the display or to enter a different bit pattern, select **EDIT BYTE**. This places the CTS850 into edit mode.

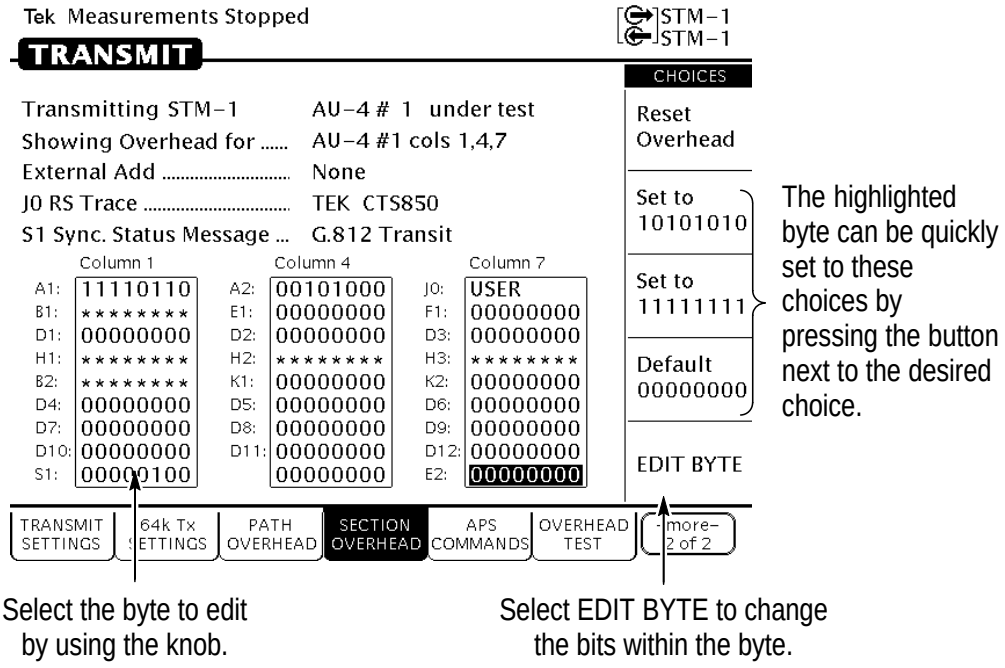


Figure 2–16: Selecting a Byte for Editing

When in edit mode, the choices along the right side of the display change (see Figure 2–17). The highlight now applies to a single bit.

3. To change the value of the highlighted bit, select either **1** or **0**. Each time you select 1 or 0, the highlighted bit is changed and the highlight moves to the next bit.
4. To select a different bit for editing, select either the right or left arrow to move the highlight. When the desired bit is highlighted, select either **1** or **0**.
5. When you are finished editing the byte, select **DONE**. This enters the changes to the byte and exits edit mode.

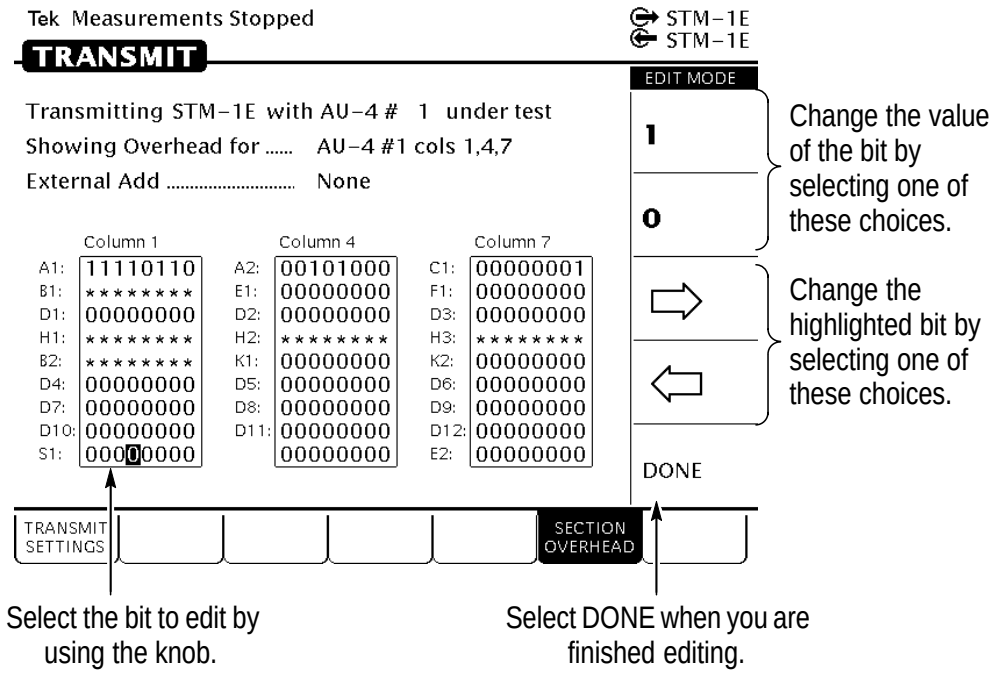


Figure 2–17: Editing a Byte

Entering Text

Several parameters, such as file names, operator prompts, and path trace messages, consist of text strings. You can set text strings to preset choices or enter your own text string. When you highlight a text parameter using the knob, the choices at the right side of the display change to present predefined text strings (if appropriate) and the option to edit the text string (see Figure 2–18).

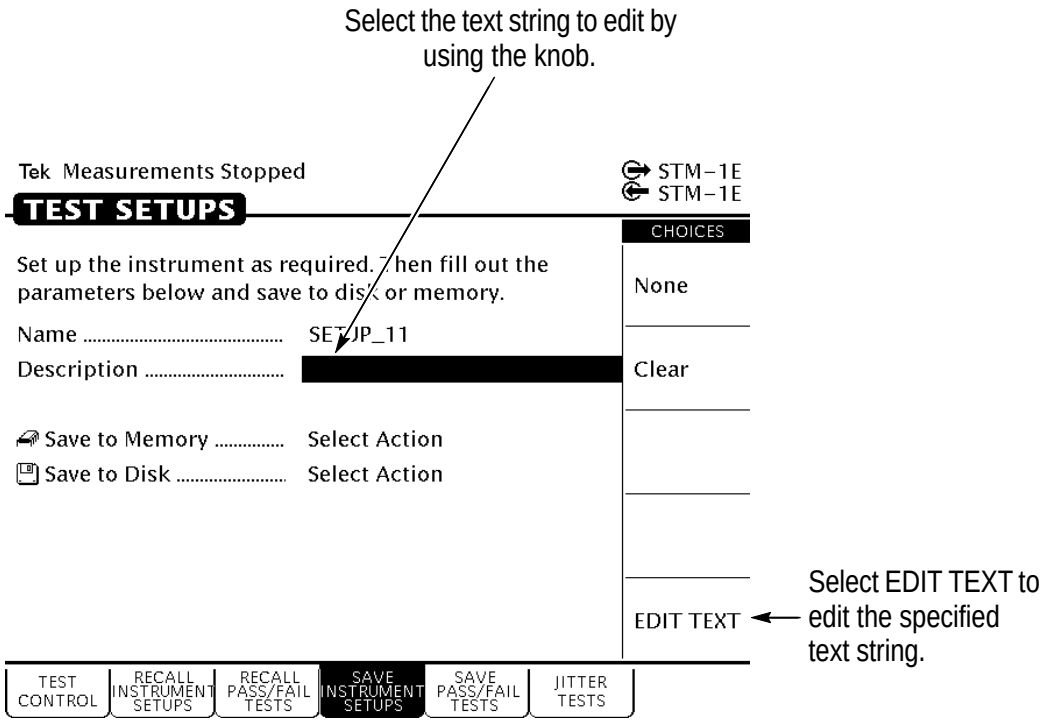


Figure 2–18: Selecting a Text String for Editing

Text strings (not file names) may contain both upper– and lower–case characters. Moving the selected characters (with the knob on the front panel) off the end of the selection string changes between upper– and lower–case.

To edit a text string:

1. Select the text string by turning the knob until the desired text string is highlighted (see Figure 2–18).
2. Select **EDIT TEXT**. This places the CTS850 into edit mode.

   When in edit mode, the choices along the right side of the display change (see Figure 2–19). In edit mode, the status line at the top of the display is replaced with a line that displays the characters available for placing into the text string. (Some characters available for message text are not available for file names.)
3. To change the highlighted character or enter a new one, select the character to enter by turning the knob.

4. To enter the selected character, select **Enter <character>**.

   To delete a character already entered, use the arrows to highlight the character. Select **Delete** to delete the character.

5. When you are finished editing the text string, select **DONE**.

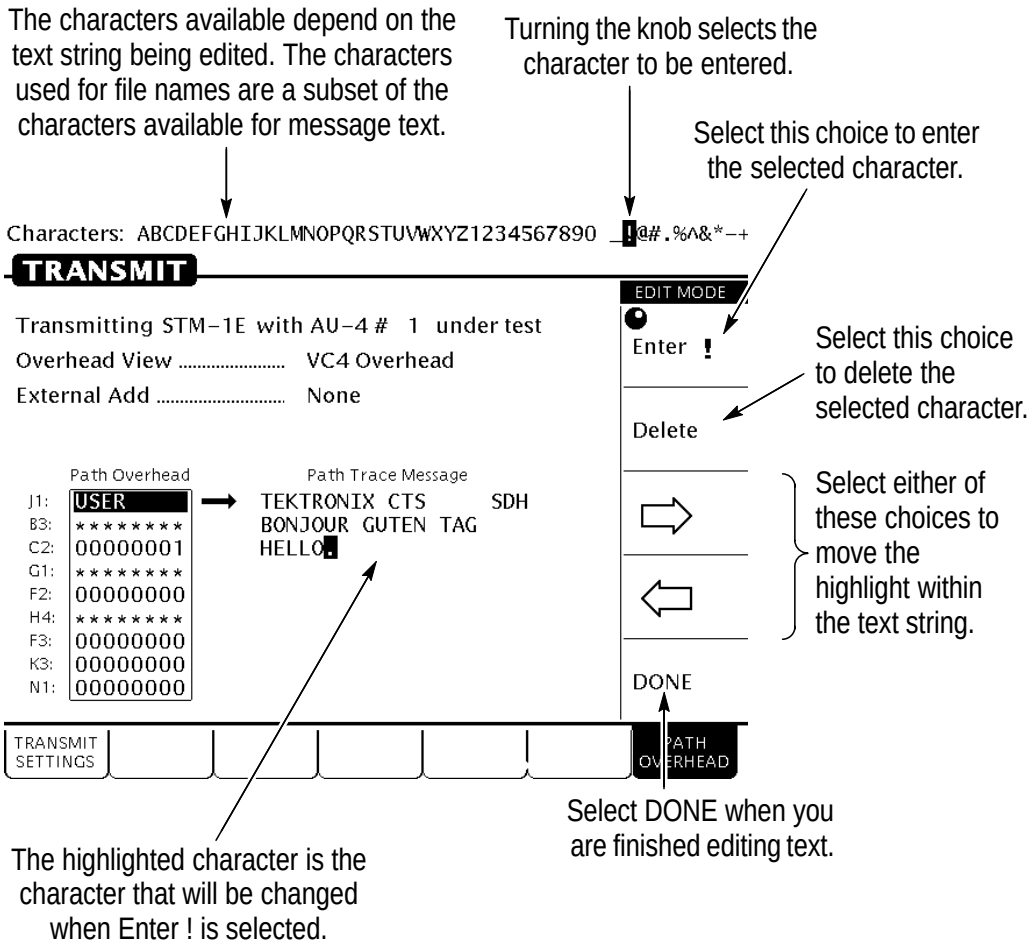


Figure 2–19: Editing a Text String

Working with the Disk Drive

Use the disk drive in the CTS850 to save instrument setups, pass/fail tests, measurement results and measurement histories. The CTS850 reads disks formatted in MS-DOS format. It reads only 1.44 MB disks. The CTS850 does not format disks. Files written to disk consist of four types, as shown in Table 2–2.

Table 2–2: CTS850 Disk File Types

File Type	Description	File Extension
Instrument Setups	Complete instrument settings	.SET
Pass/Fail Tests	Complete instrument settings, operator prompts, and Fail If conditions	.TST
Measurement Results[1]	ASCII file listing the results of a test	.RES
Measurement History[1]	Binary file containing history of test results	.HIS
Jitter Tolerance Conformance Tests	ASCII file listing results of a conformance test	.JTL
	Microsoft Excel-compatible file containing test and mask data	.XTL
Jitter Transfer Conformance Tests	ASCII file listing results of a conformance test	.JTR
	Microsoft Excel-compatible file containing test and mask data	.XTR
Pointer Jitter Conformance Tests	ASCII file listing results of a conformance test	.PTR
Output Jitter Conformance Tests	ASCII file listing results of a conformance test	.OUT

1 **The CTS850 creates two files (with extensions .RES and .HIS) when you save measurement test results.**

The CTS850 displays only file names with the extensions shown in Table 2–2. Disk files with any other extensions do not appear in file name displays.

Reading Files on Disk

You can display disk file names in three places: the RECALL INSTRUMENT SETUPS page and the RECALL PASS/FAIL TESTS page of the TEST SETUPS menu, and the RECALL RESULTS page of the RESULTS menu.

To view instrument setups files on a disk:

1. Insert the disk into the disk drive.
2. Press the **TEST SETUPS** front-panel button to display the TEST SETUPS menu.
3. Select the **RECALL INSTRUMENT SETUPS** page.
4. Select **Disk** to display the instrument setups on disk.

To view pass/fail files on a disk:

1. Insert the disk into the disk drive.
2. Press the **TEST SETUPS** front-panel button to display the TEST SETUPS menu.
3. Select the **RECALL PASS/FAIL TESTS** page.
4. Select **Disk** to display the pass/fail tests on disk.

To view test results files on a disk:

1. Insert the disk into the disk drive.
2. Press the **RESULTS** front-panel button to display the RESULTS menu.
3. Select the **RECALL RESULTS** page.
4. Select **Disk** to display the test results files on disk.

NOTE. *Disk operations may take several seconds if there are many files on the disk. The light on the front of the disk drive turns off when the disk operation is complete.*

Synchronous, Plesiochronous, Asynchronous

To understand correctly the concepts and details of SDH, it is important to be clear about the meaning of *Synchronous, Plesiochronous*, and *Asynchronous*.

In a set of **Synchronous** signals, the digital transitions in the signals occur at exactly the same rate. There may however be a phase difference between the transitions of the two signals, and this would lie within specified limits. These phase differences may be due to propagation time delays, or wander introduced in the transmission network. In a synchronous network, all the clocks are traceable to one Primary Reference Clock (PRC). The accuracy of the PRC is better than ± 1 in 10^{11} and is derived from a cesium atomic standard.

If two digital signals are **Plesiochronous**, then their transitions occur at ”almost” the same rate, with any variation being constrained within tight limits. These limits are set down in ITU–T recommendation G.811. For example, if two networks need to interwork, their clocks may be derived from two different PRCs. Although these clocks are extremely accurate, there is a small frequency difference between one clock and the other. This is known as a plesiochronous difference.

In the case of **Asynchronous** signals, the transitions of the signals do not necessarily occur at the same nominal rate. Asynchronous, in this case, means that the difference between two clocks is much greater than a plesiochronous difference. For example, if two clocks are derived from free–running quartz oscillators, they could be described as asynchronous.

Plesiochronous Digital Hierarchy (PDH)

Traditionally, digital transmission systems and hierarchies have been based on multiplexing signals which are plesiochronous (running at almost the same speed). Also, various parts of the world use different hierarchies which lead to problems of international interworking, for example, between those countries using 1.544 Mbit/s systems (U.S.A. and Japan) and those using the 2.048 Mbit/s system.

In the PDH, tributaries and higher–order bit streams are allowed to deviate from a pre–defined bit rate by a specified amount. The justification (bit stuffing) process is required which brings all the tributaries up to the same bit rate before multiplexing takes place. However, the justification method makes it impossible to identify the location of specific tributary channels within a higher–order bit stream, without demultiplexing back down to the 2 Mb/s tributaries.

To recover a 64 kbit/s channel from a 140 Mbit/s PDH signal, it is necessary to demultiplex the signal all the way down to the 2 Mbit/s level before the location of the 64 kbit/s channel can be identified. PDH requires ”steps” (140–34, 34–8, 8–2 demultiplex; 2–8, 8–34, 34–140 multiplex) to drop out or add an individual speech or data channel. This is due to the bit–stuffing used at each level. Extra bits are added (stuffed) in to the digital tributaries which increases the speed of the tributaries until they are all identical.

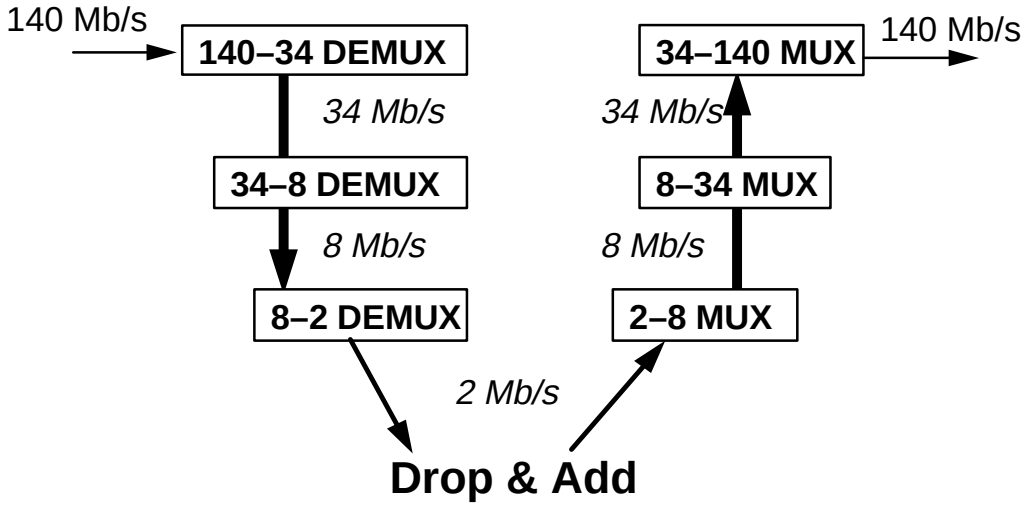


Figure 2–20: PDH Multiplexing by steps showing add/drop function

Anomaly, Defect, Failure, Alarm

Anomaly – The smallest discrepancy which can be observed between the actual and desired characteristics of an item. The occurrence of a single anomaly does not constitute an interruption in the ability to perform a required function.

Defect – The density of anomalies has reached a level where the ability to perform a required function has been interrupted. Defects are used as input for performance monitoring, the control of consequent actions, and the determination of fault cause.

Failure – The inability of a function to perform a required action persisted beyond a maximum time allocated.

Alarm – The maintenance signal used in the digital network to alert downstream equipment that a defect or equipment failure has been detected.

SDH Multiplexing Principles

The multiplexing principles of SDH follow:

- **Mapping** – A process used when tributaries are adapted into Virtual Containers (VCs) by adding justification bits and Path Overhead (POH) information.
- **Aligning** – This process takes place when a pointer is included in a Tributary Unit (TU) or an Administrative Unit (AU), to allow the first byte of the Virtual Container to be located.
- **Multiplexing** – This process is used when multiple lower–order path layer signals are adapted into a higher–order path signal, or when the higher–order path signals are adapted into a Multiplex Section.
- **Stuffing** – SDH has the ability to handle various input tributary rates from PDH. As the tributary signals are multiplexed and aligned, some spare capacity has been designed into the SDH frame to provide enough space for all these various tributary rates. Therefore, at certain points in the multiplexing hierarchy, this space capacity is filled with ”fixed stuffing” bits that carry no information, but are required to fill up the particular frame.

The figure on the next page illustrates the ITU–T SDH multiplexing structure. The notations in the boxes, such as C–1, VC–3, and AU–4, are explained in the table after the figure. Not all containers and rates shown in this figure are specifically handled by the CTS 850 test unit.

At the lowest level, containers (C) are input to virtual containers (VC). The purpose of this function is to create a uniform VC payload by using bit–stuffing to bring all inputs to a common bit–rate ready for synchronous multiplexing. Various containers (ranging from VC–11 at 1.728 Mb/s to VC–4 at 139.264 Mb/s) are covered by the SDH hierarchy. Next, VCs are aligned into tributary units (TUs), where pointer processing operations are implemented.

These initial functions allow the payload to be multiplexed into TU groups (TUGs). As the figure illustrates, the xN label indicates the multiplexing integer used to multiplex the TUs to the TUGs. The next step is the multiplexing of the TUGs to higher level VCs, and TUG–2 and TUG–3 are multiplexed into VC–3 (ANSI mappings) and VC–4. These VCs are multiplexed with fixed byte–stuffing to form administration units (AUs) which are finally multiplexed into the AU group (AUG). This payload then is multiplexed into the Synchronous Transport Module (STM).

Figure 2–21: SDH Multiplexing Hierarchy

Table 2–3: SDH Multiplexing Structure

Term	Contents	Description
C–n	n = 1 to 4	payload at lowest multiplexing level
VC–n	n = 1,2	single C–n plus VC POH
VC–n	n = 3,4	C–n, TUG–2s or TU–3s, plus POH for the specific level
TU–n	n = 1 to 3	VC plus tributary unit pointer
TUG–2	(TU–n) = 1,3,4	various TU–n s
TUG–3	TU–3, 7 TUG–2s	TU–3, 7 TUG–2s
AU–n	n = 3,4	VCs plus AU pointer
STM–n	n = 1, 3 AUGs	n synchronously– multiplexed STM–1 signals

POH = Path Overhead; C = Container; TU = Tributary Unit; AU = Administrative Unit; VC = Virtual Container; TUG = Tributary Unit Group; STM = Synchronous Transport Module

Difference in Telecommunications Terms

Three sets of terms are listed here because it is important to see that they are not equivalent terms, which is how they get used in normal discussions. They are:

Add/ Drop

The process where a part of the information carried in a transmission system is extracted (dropped) at an intermediate point and different information is inserted (added) for subsequent transmission. The remaining traffic passes straight through the multiplexer without additional processing.

Map/ Demap

For the CTS 850, this term refers to putting PDH signals into and getting PDH signals out of a SDH signal.

Multiplex/ Demultiplex

Multiplex (MUX) – To transmit two or more signals over a single channel. Demultiplex (DEMUX) – To separate two or more signals previously combined by compatible multiplexing equipment.

45 Mbit/s Map/Demap Implementation

If your CTS 850 test set supports the 45 Mb/s map/demap option (Option 55), the following is an overview of what the 45 Mb/s option offers.

To determine if Option 55 is present in the CTS 850 test set, press the Utility button on the front panel, then press the Instrument Configuration (INST CONFIG) softkey. In the menu that is displayed after pressing this button and softkey, there is a line that says Options. In this line, should be the number 55, for Option 55. Also, in the line that says PDH Options, should be the number 45, for 45 Mb/s.

45 Mbit/s is transmitted or received as a B3ZS or HDB3 encoded line rate, and mapped or demapped into a VC–3 structure into an STM–1. Mapping and demapping has the same configuration, options and nomenclature as the current TU–3 mapping/demapping selections available for 34 Mbit/s signals.

An external 45 Mbit/s payload is added when the signal is being mapped into an SDH output. The user can insert the same defects and anomalies as are supported in a 34 Mbit/s externally–added signal.

Demapped payloads are dropped out through the front panel as a 45 Mbit/s line rate.

The payload for 45 Mbit/s is PRBS, a fixed 8, 16, or 24–bit pattern, or externally–added data only. The payload can not be muxed or demuxed from or into DS1 or any PDH rates. The same PRBS patterns as for 34 Mbit/s are supported. Overhead bytes are the same as for TU–3 mapping and demapping. The default C2 value is the same for 34 Mbit/s (0x04).

There is no support for 45 Mbit/s bit slip measurements.

G.821, G.826 and M.2100 analysis is performed on the received 45 Mbit/s signal, subject to the same restrictions as other PDH signals.

Because of architectural limitations, the PDH rates (2 Mbit/s, 8 Mbit/s, 34 Mbit/s, and 140 Mbit/s) are not supported at the same time as 45 Mbit/s. The RX and TX sides of the tributary card are “linked” at 45 Mbit/s. The tributary board will run RX and TX at 45

Mbit/s or RX and TX at any of the existing PDH rates, but 45 Mbit/s and 2/8/34/140 Mbit/s cannot be turn simultaneously.

The framing for 45 Mbit/s is C–Bit, M13 or Unframed. From the user interface, external add will be handled as a framing option, in the same manner as the other PDH rates are handled.

RX signal level for 45 Mbit/s are Normal and Monitor.

Defect insertion for 45 Mbit/s is: Pattern Bit; Framed Bit (framed only); Frame Bit Burst; C–bit parity (C–bit framing only); P–bit parity (M13 framing only); and, Code violations (45 Mbit/s only)

Anomaly insertion for 45 Mbit/s is RDI (frame signals only); AIS (framed only) and Idle (framed only).

Failure insertion for 45 Mbit/s is LOS (only when 45 Mbit/s is the TX line rate).

Tutorial

The tutorial acquaints you with the features of the CTS850 by having you run a test while you explore specific features of the CTS850 SDH/PDH Test Set. For full details on how to use the CTS850, refer to Chapter 3– *Reference*.

The tutorial presents procedures in tables. Perform the procedure by reading from left to right in the table (see example below). The word *none* in a cell indicates that no action is required.

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
Begin with Step 1	Step 2	Step 3	Step 4
		Step 5	Step 6
		Step 7	Step 8, CTS850 instruction is complete

Some procedures require several iterations of highlighting parameters and selecting choices. Some procedures may require more than one menu button or menu page selection as well.

Note: Use the buttons below the display to Select Menu Page. Use the rotary knob to Highlight Parameter. Use the buttons to the right of the display to Select Choice.

Before Turning On the CTS850

This tutorial describes how to perform a bit-error rate (BER) test on an STM-1E signal. To perform the tutorial, you need a 75 Ω coaxial cable with BNC connectors on each end. This tutorial assumes you have set up the CTS850 as described in *First Time Operation*, in Chapter 1 – Getting Started.

To set up your CTS850 for the tutorial, perform these steps:

- Check to see that the CTS850 is turned off.

Connect the coaxial cable between the **TRANSMIT** and **RECEIVE** BNC connectors on the front panel (see Figure 2–22).

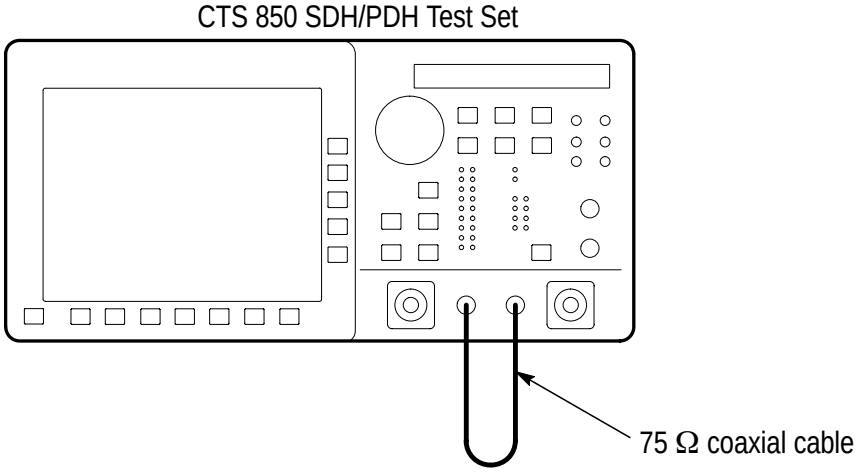


Figure 2–22: Setup for the Tutorial

Press the **ON/STBY** button to turn on the CTS850.

The CTS850 performs its power-on self test and then displays the TRANSMIT menu.

Before proceeding with the tutorial, initialize the CTS850 as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	RECALL INSTRUMENT SETUPS	DEFAULT FACTORY SETTINGS	Recall Setup

Setting Transmit Parameters

Before beginning the BER test, set the transmit and receive parameters.

To set the transmit and receive parameters:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	TRANSMIT SETTINGS	Transmit Rate (see Figure 2–23)	STM-1E

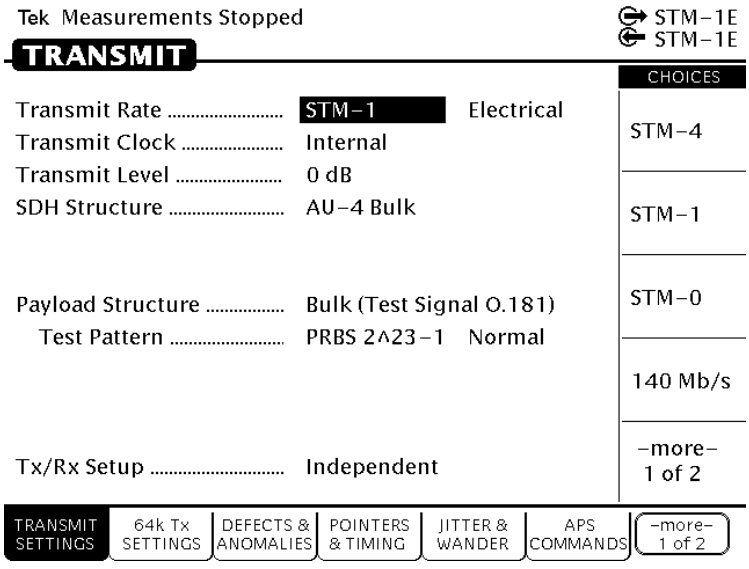


Figure 2–23: The TRANSMIT SETTINGS Page of the TRANSMIT Menu

To set the payload and the test pattern:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
		Payload	Bulk (Equipped)
		Test Pattern	PRBS 2^20–1

Setting Receive Parameters

You can set receive parameters two ways. The first way is to set the parameters individually: display the RECEIVE menu and set each parameter manually on the RECEIVE SETTINGS page. The second way is to couple the receive settings to the transmit settings. To do this, use the Tx/Rx Setup line on the TRANSMIT SETTINGS page. (The Tx/Rx Setup line appears on both the TRANSMIT SETTINGS page and the RECEIVE SETTINGS page. To couple transmit settings to the receive settings, you would use the Tx/Rx Setup line on the RECEIVE SETTINGS page.)

To couple the receive settings to the transmit settings:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	TRANSMIT SETTINGS	Tx/Rx Setup	Coupled

As soon as you select Coupled, the icon in the status area changes to indicate the Tx/Rx Setup are coupled.

If the operator couples from the TRANSMIT SETTINGS menu, the TX settings copy to the Receive side of the test unit. If the operator couples from the RECEIVE SETTINGS menu, the RX settings copy to the Transmit side of the test unit.

Setting the Test Time

Before beginning the BER test, you must specify the duration of the test.

To set the duration of the test:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS (see Figure 2–24)	TEST CONTROL	Test Duration	15 min

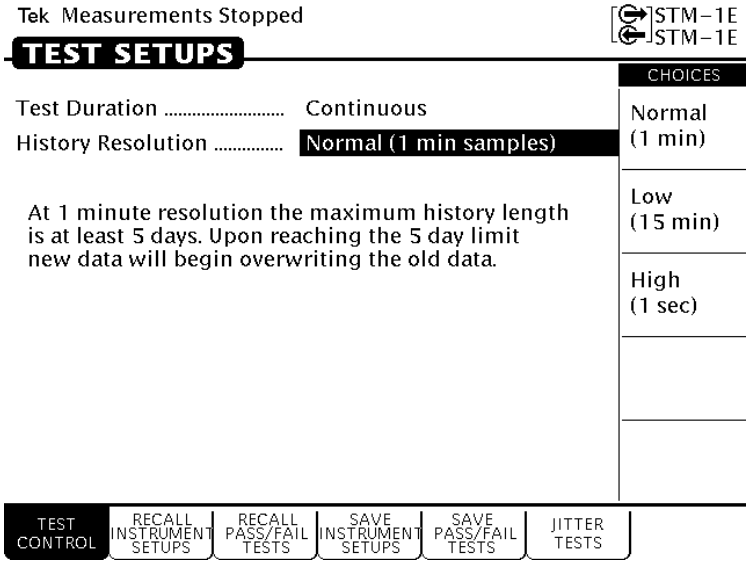


Figure 2–24: The TEST CONTROL Page of the TEST SETUPS Menu

Where Test Results Are Displayed

Once you have set the transmit and receive parameters and the test time, you can begin the test. However, before starting the test, look at the RESULTS menu where the results of the test appear.

To display the RESULTS menu:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
RESULTS	TEST Summary	*none*	*none*

The TEST SUMMARY page contains a summary of the current or most recent test (see Figure 2–25). Just below the menu name is information about the current or most recent test. If the test detected no alarms or errors, the CTS850 displays the message No Alarms No Errors.

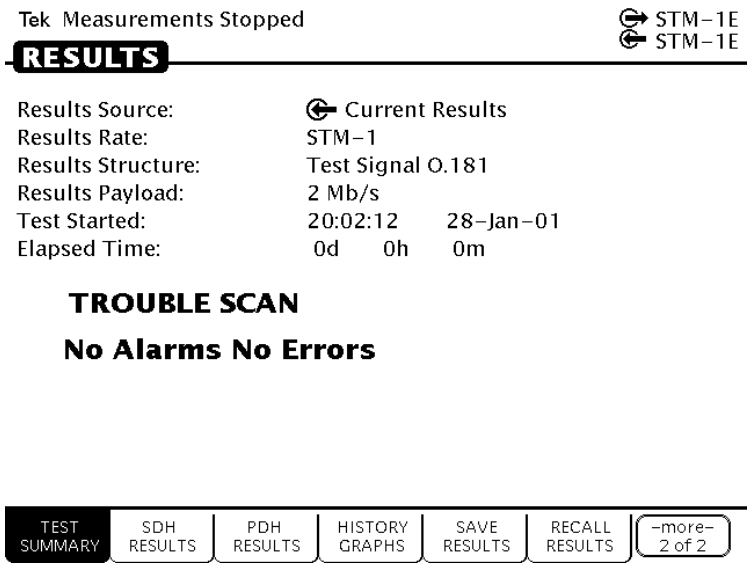


Figure 2–25: The TEST SUMMARY Page of the RESULTS Menu

The RESULTS menu contains ten pages on which results are displayed: TEST SUMMARY, SDH or PDH RESULTS, ERROR ANALYSIS, Performance Analysis, JITTER & WANDER, and HISTORY GRAPHS. Select **SDH RESULTS** to see one way test results are displayed (see Figure 2–26).

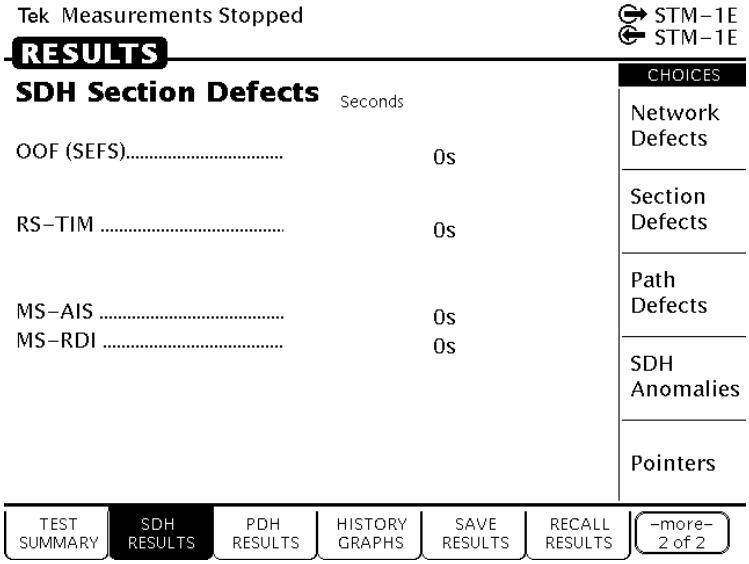


Figure 2–26: SDH Results, SDH Section Defects, from RESULTS menu

The SDH or PDH RESULTS page contains a listing of the different errors that can occur. Since you have not started your test yet, the values are those of the last test run. To continue with the test setup, select TEST SUMMARY.

Begin the Test

Note at the top of the display the message Measurements Stopped. When you start the test, this message will change. To start the test, press the front-panel **START/STOP** button.

Once a test starts, the display changes in two ways. First, the message Running appears at the top of the display (see Figure 2–27). This message line is always visible so you know that a test is running, even if a page is displayed that doesn't contain any information about tests. Second, the test status indicator appears.

There are two elements to the test status indicator. The text above the bar graph indicates how long the test has been running. The text lists the days, hours, minutes, and seconds the test has been running. The bar graph indicates what percentage of the test is complete (except when the test duration is set to continuous).

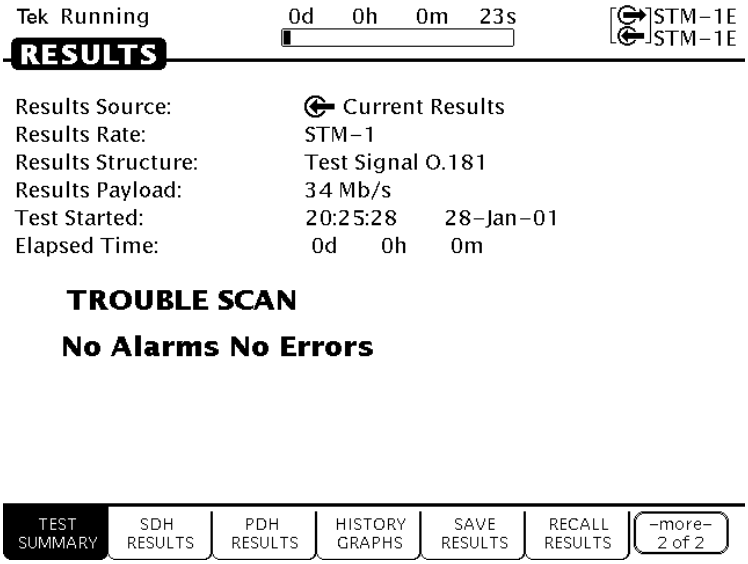


Figure 2–27: The Message Line and Test Status Indicator

Inserting Errors

Now that the test is running, you will insert some errors and see how the CTS850 responds. To set the error insertion parameters, first display the Defects & Anomalies page as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	Defects & Anomalies (see Figure 2–28)	*none*	*none*

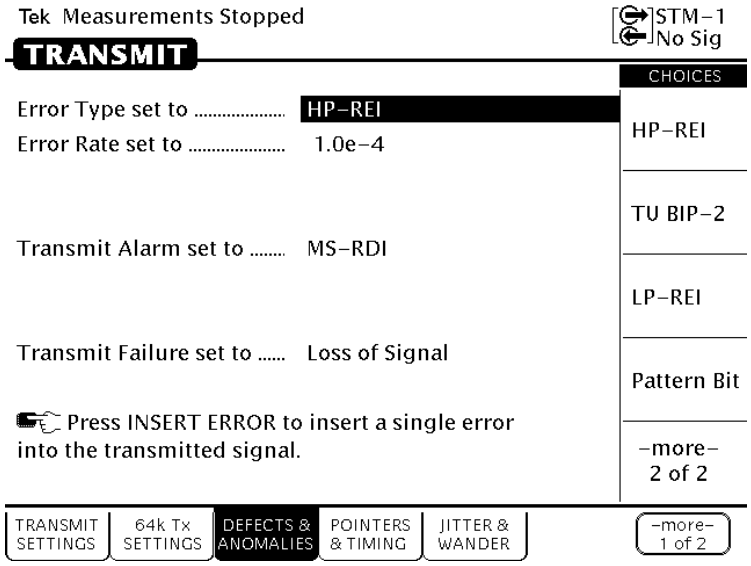


Figure 2–28: The Defects & Anomalies Page of the TRANSMIT Menu

There are two ways to insert errors into the transmitted signal. You can insert errors one at a time or you can set a rate at which the CTS850 inserts errors automatically. Before inserting errors, you must specify the type of error to be inserted. You specify the type of error to be inserted with the Error type set to parameter.

To set the type of error to insert:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
		Error type set to	Path B3 BIP

The rate at which errors are inserted is specified on the Error rate set to parameter. An error rate of None specifies that no errors are inserted unless the INSERT ERROR button is pressed. Any error rate

other than None results in a continuous stream of errors being inserted into the transmitted signal.

To insert a single error, press the **INSERT ERROR** button located on the front panel.

When you press the INSERT ERROR button the red ERROR light flashes.

To insert a continuous stream of errors:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
		Error rate set to	1.0E-5

Note that the red ERROR light now stays on all the time; errors are being detected continually.

To turn off the automatic error insertion:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	Defects & Anomalies	Error Rate set to	None

Now that errors are no longer being transmitted, the red ERROR light has gone out, although the yellow history light is still on. To clear the error history, press **CLEAR HISTORY**.

Adjusting Pointers

The CTS850 enables you to adjust or move pointers. Note that pointer movements are not necessarily errors. Pointer parameters are set on the POINTERS & TIMING page of the TRANSMIT menu.

To display the POINTERS & TIMING page:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	POINTERS & TIMING (see Figure 2–29)	*none*	*none*

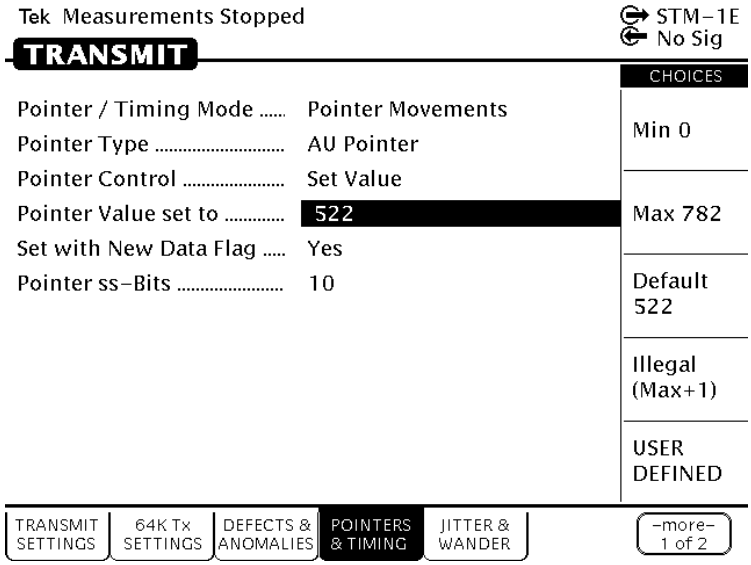


Figure 2–29: Example of Pointers & Timing Page of TRANSMIT Menu

Before adjusting a pointer, you must decide what mode of pointer movement to use. You can change a pointer by adjusting the pointer directly or by using frequency offset. The default mode is Pointer Movements, which allows you to adjust pointers directly.

To specify how the pointer will be adjusted:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
		Pointer Control	Single

After selecting Single for pointer control, a message displays that tells you how to adjust the pointer. Pointer movement alternates between increment and decrement.

To adjust a pointer, press the **POINTER ACTION** button on the front panel of the test set.

Each time you press the **POINTER ACTION** button, a pointer adjusts and the **POINTER ACTION** light turns on. Also, a message appears at the top of the display that describes the type of pointer movement that occurs. On this page you can also adjust frequency offset which may cause a network element to generate pointer movements.

Be aware that it is necessary to press the Start/Stop button the front panel to see all the changes. To see the pointer value changing

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
RESULTS	SDH or PDH RESULTS	*none*	Pointers

Now press the **POINTER ACTION** button again.

To adjust a pointer using frequency offset:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	POINTERS & TIMING	Pointer / Timing Mode	Frequency Offset

After selecting Frequency Offset, note that the available parameters change. When in Frequency Offset mode, the only parameters that can be set are Offset Mode and Frequency Offset.

To change the frequency offset of the signal:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
		Frequency Offset	Stress +4.6ppm

If the preset choices do not match what you need, use USER DEFINED to define an alternative.

To define a specific frequency offset:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
			USER DEFINED

When you select USER DEFINED, the knob is assigned to adjust the frequency offset. Two choices are available in this mode: Coarse and Fine (see Figure 2–30). Coarse adjusts the frequency offset by 10 ppm. Fine adjusts the frequency offset by 0.1 ppm. The larger the value for frequency offset, the more often the pointer is adjusted.

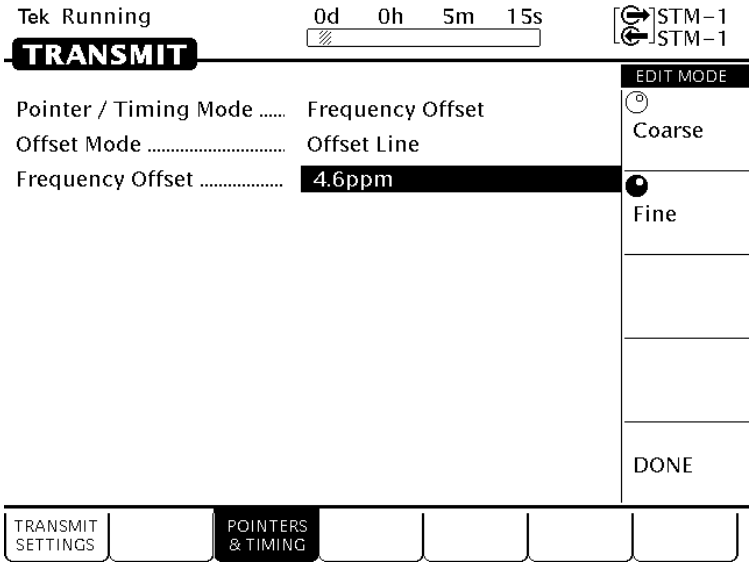


Figure 2–30: Adjusting Frequency Offset Using the Knob

Use the knob to change the value of Frequency Offset; select any value you wish. When you are finished selecting a frequency offset:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
			DONE

To turn off frequency offset:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	POINTERS & TIMING	Frequency Offset	Default 0ppm

Selecting Default 0ppm sets the Frequency Offset back to 0 ppm.

Viewing Section Overhead

The CTS850 allows you to view the section overhead for the transmitted or received signal. To view the section overhead for the transmitted signal, press the MORE 1of 2 Key softkey at the bottom of the test set screen, in order to see more choices:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	SECTION OVERHEAD	*none*	*none*

The first line of text under the menu name describes the signal being received and the AU under test (see Figure 2–31).

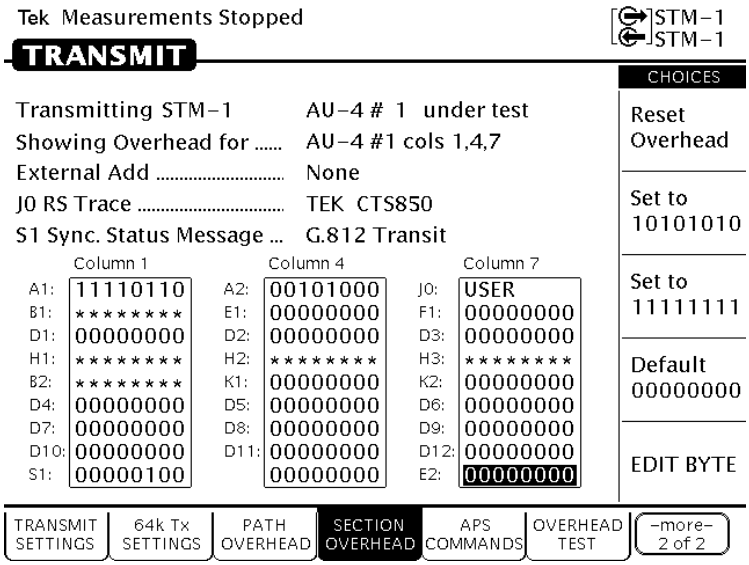


Figure 2–31: Example of Section Overhead Page of TRANSMIT Menu

The Showing Overhead for parameter identifies which columns of the section overhead are displayed. To display the overhead for other overhead columns within the signal, select the appropriate choice.

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
		Showing Overhead for	Cols 1, 4, 7

Editing the Section Overhead

Except for certain reserved bytes, you can edit the bytes of the section overhead of the transmitted signal. Reserved bytes are identified by asterisks (*) in the byte content area of the displayed column.

To edit a byte of the section overhead:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
		S1 *byte*	**EDIT BYTE**

Once you have selected EDIT BYTE, the CTS850 enters the edit mode (see Figure 2–32).

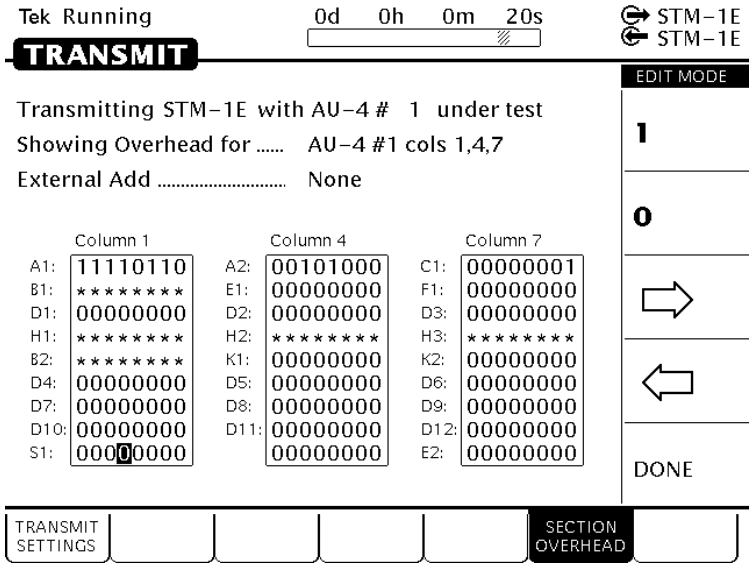


Figure 2–32: The Display in Edit Mode

To change the value of any bit within the byte, highlight the bit you wish to change. To change the value of the highlighted bit, select either 1 or 0. After you assign a value to the highlighted bit, the highlight moves to the next bit to be edited.

Edit the S1 byte to read **10101010**.

Select **DONE** when you have finished editing the byte.

You can assign preset values to the highlighted byte. For example, rather than editing each bit of the byte as you just did, you could also have selected Set to 10101010. To see that the CTS850 is now receiving the new value of the S1 byte:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
RECEIVE	SECTION OVERHEAD	*none*	*none*

Verify that the section overhead for columns 1, 4, and 7 is displayed. If it is not:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
		Showing Overhead for	Cols 1, 4, 7

Look at the value of the S1 byte. You will see that it is 10101010, as previously set.

Viewing Test Results

The test has been running for several minutes and errors have been transmitted. To see the test results, you must display the RESULTS menu. To display the RESULTS menu:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
RESULTS	TEST SUMMARY	*none*	*none*

The TEST SUMMARY page identifies the most common errors that the CTS850 has detected. You will see a line that identifies the worst error rate detected and may find listings for other types of errors (see Figure 2–33).

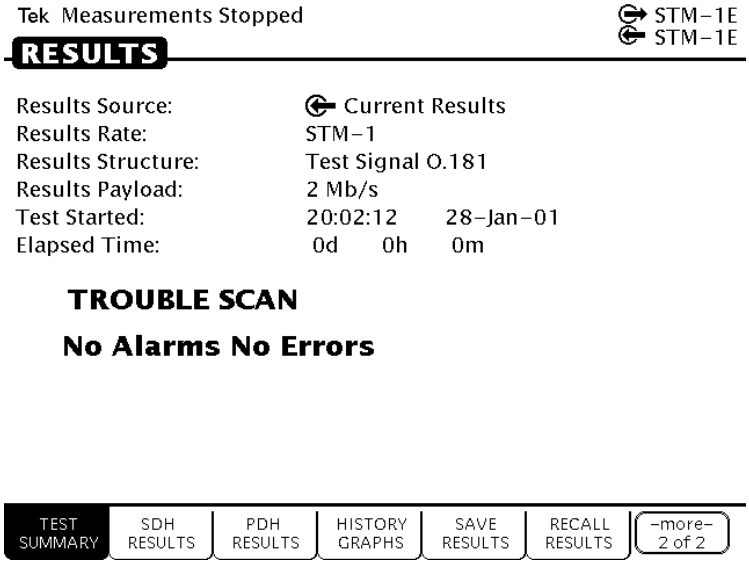


Figure 2–33: The TEST SUMMARY Page of the RESULTS Menu

The SDH or PDH RESULTS page displays all the errors that have been detected. It also displays the error ratio and the number of errored seconds that have been logged (see the following figure).

To display the SDH or PDH RESULTS page:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
	SDH or PDH RESULTS	*none*	*none*

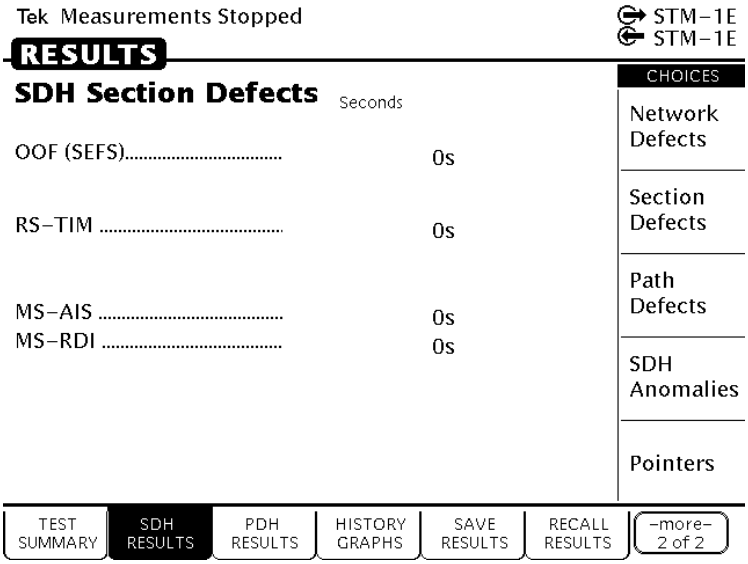


Figure 2–34: SDH Results, SDH Section Defects, from RESULTS menu

This completes the tutorial. For detailed information on CTS850 capabilities, refer to Chapter 3 – *Reference*.

Reference

Basic Test Procedures

This section gives examples of how to set up and use the CTS850 SDH/PDH Test Set for several common telecommunication network applications:

- Network continuity checking
- Transmission signal quality testing
- Fault tolerance testing
- Performance monitoring
- Jitter and wander testing
- Video timing quality testing

Setting Up the CTS850

This section presents setup instructions for the CTS850 in tables. Perform the steps reading from left to right in the table (see example below). The word *none* in a cell indicates that no action is required.

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
Begin here with Step 1	Step 2	Step 3	Step 4
		Step 5	Step 6
		Step 7	Step 8, CTS850 Setup is complete

Menu buttons are located on the instrument front panel. Select menu pages with the buttons below the display. Use the knob to highlight a parameter; then use the buttons at the right to select a choice. Many setups require several iterations of highlighting parameters and selecting choices. Some setups may require more than one menu button or menu page selection as well.

The first step in each application setup initializes the CTS850 to a known state.

Network Continuity Checking

With the AUTOSCAN feature of the CTS850, it is easy to make a quick continuity check. The continuity check verifies that a SDH network element (NE), or portion of the network, is correctly set up and provisioned and that the signal passes through intact. In this example, the CTS850 transmits an STM-1E signal into an NE. Then the CTS850 receives the output from the NE and verifies that the AU-4, including its payload patterns, is intact.

1. Connect the CTS850 to the NE as shown in Figure 3–1.

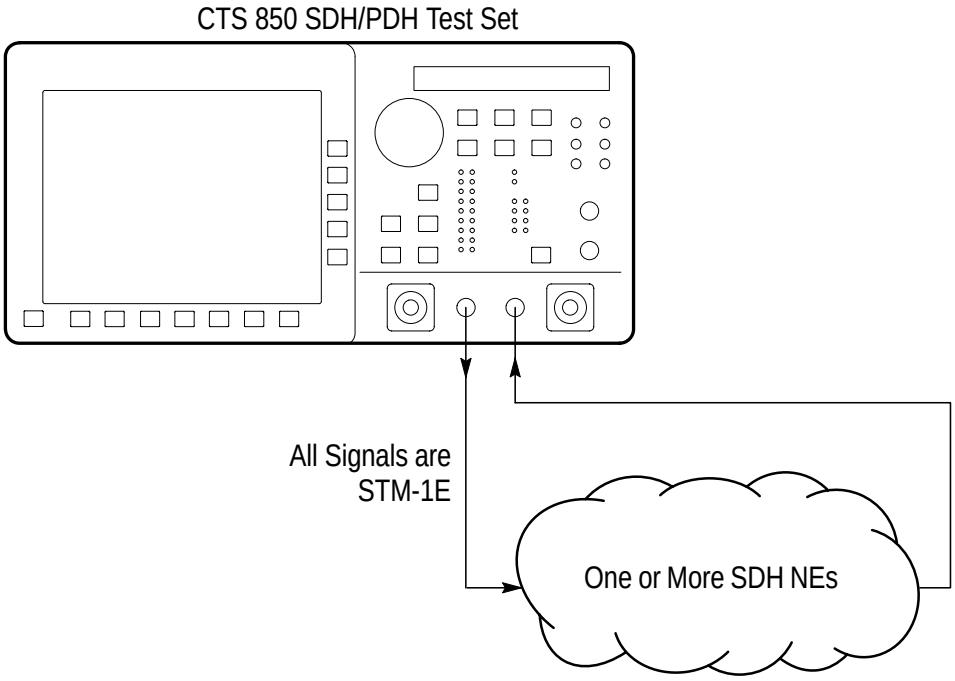


Figure 3–1: Setup to Check Network Continuity

2. Set up the CTS850 as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	RECALL INSTRUMENT SETUPS	DEFAULT FACTORY SETTINGS	Recall Setup
TRANSMIT	TRANSMIT SETTINGS	Transmit Rate	STM-1E

3. Press the **AUTOSCAN** button. The receiver locks onto the output from the NE, displays the signal structure, and shows information about the content of AU #1.
4. To analyze the payload pattern, select **Show Payload**. The CTS850 detects a PRBS of length 2^{23}–1.
5. Check the J1 Path Trace for any message.
6. Check the front-panel status lights to verify that there are no errors, alarms, or failures.
7. Select **EXIT** to leave the AUTOSCAN dialog box.

Transmission Signal Quality Testing

Measuring Bit Error Rate

The bit error rate (BER) test is one of the best ways to measure the quality of an SDH transmission link. You can use the CTS850 to make a BER test on a two-way link that is connected in a loop-back configuration. If this is a test you perform often, save it as a pass/fail test for easy recall.

1. Connect the CTS850 to a network as shown in Figure 3–2.

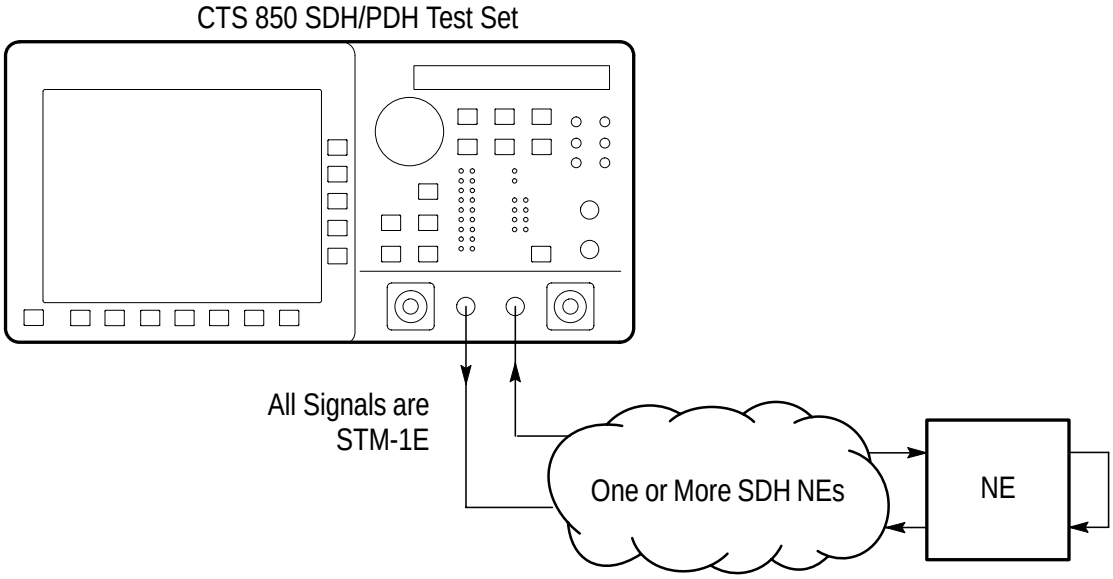


Figure 3–2: Setup to Check a Transmission Link

2. Set up the CTS850 as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	RECALL INSTRUMENT SETUPS	DEFAULT FACTORY SETTINGS	Recall Setup
TRANSMIT	TRANSMIT SETTINGS	Transmit Rate	STM-1E
		Payload	Bulk Fill (Equipped)
		Tx/Rx Setup	Coupled
TEST SETUPS	TEST CONTROL	Test Duration	15 Minutes
RESULTS	SDH RESULTS	*none*	SDh Anomalies

3. Press the **START/STOP** button.

4. While the test is running, the CTS850 counts errors and errored seconds and then calculates the error ratio for each error type or errored seconds.

5. After 15 minutes have elapsed, the test stops automatically and the measured results are held on the SDH RESULTS page until another test is started.

6. When the test is complete, you can store the test results to disk or print out a hardcopy. To save the test results to disk, you must enter a name for the disk file as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
RESULTS	SAVE RESULTS	Name	EDIT NAME

7. Enter an eight-character name for the file.

8. If you wish, you can also enter a description of the test results by highlighting **Description** and selecting **EDIT TEXT**.

9. Save the test results to disk as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
		Save to Disk	Save Current

Testing Mapping and Demapping (All PDH rates)

The following map/demap procedure applies to all PDH rates in the CTS 850 test set: 2 Mb/s, 8 Mb/s, 34 Mb/s 45 Mb/s and 140 Mb/s. The example is written in terms of a 2 Mb/s signal, but the basic test procedure would be the same in all other PDH rates.

To test that a 2 Mb/s signal is correctly mapped into an SDH signal, you would use a Bit Error Rate test. However, testing mapping/ demapping requires a different test setup than that described on page 3–3.

In this example, the Transmitter is generating a 2 Mb/s test signal which is mapped into a STM–1 signal by the Add/Drop Mux. The Receiver monitors the STM–1 signal received from the Add/Drop Mux, demaps the 2 Mb/s test signal and verifies the test pattern received.

1. Connect the CTS850 to an Add/Drop Multiplexer (ADM) as shown in Figure 3–3.

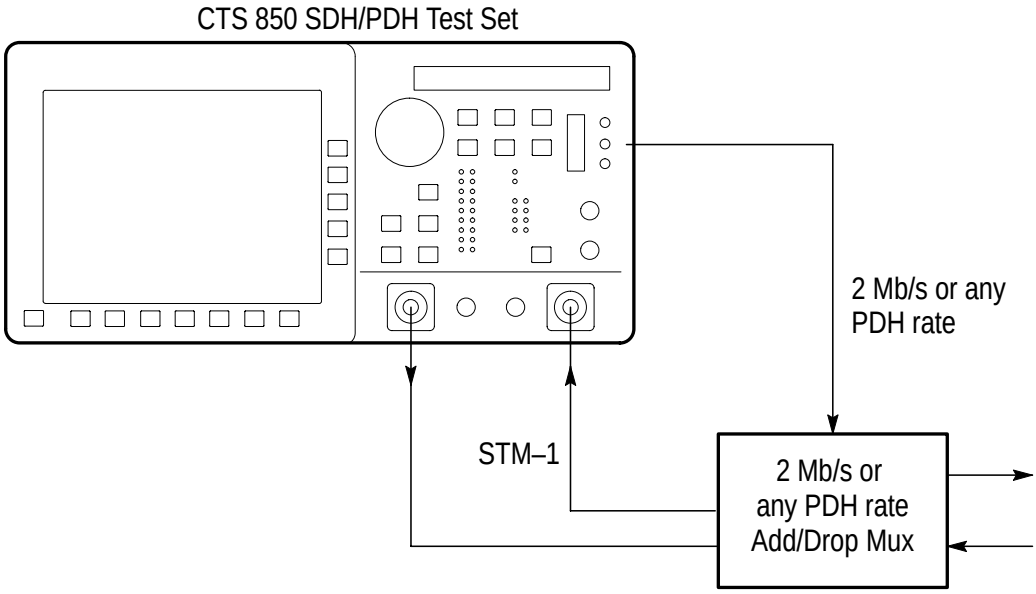


Figure 3–3: Setup to Test Mapping and Demapping

2. Set up the CTS850 as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	RECALL INSTRUMENT SETUPS	DEFAULT FACTORY SETTINGS	Recall Setup
TRANSMIT	TRANSMIT SETTINGS	Transmit Rate	2 Mb/s or any PDH rate
RECEIVE	RECEIVE SETTINGS	Receive Rate	STM-1
		Structure	TU–12 Async or applicable TU–x
		TU Under Test	*Set to match how the NE is provisioned*
		Payload	2 Mb/s Unframed or any PDH rate
TEST SETUPS	TEST CONTROL	Test Duration	15 Minutes
RESULTS	SDH RESULTS	*none*	Defects

3. Press the **START/STOP** button.

While the test is running, the CTS850 counts errors and errored seconds and then calculates the error ratio for each error type.

After 15 minutes have elapsed, the test stops automatically and the measured results are held on the SDH RESULTS page until another test is started.

4. When the test is complete, you can store the test results to disk or print out a hardcopy. To save the test results to disk, you must enter a name for the disk file as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
RESULTS	SAVE RESULTS	Name	EDIT NAME

5. Enter an eight-character name for the file.
6. If you wish, you can also enter a description of the test results by highlighting **Description** and selecting **EDIT TEXT**.
7. Save the test results to disk as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
		Save to Disk	Save Current

Fault Tolerance Checking

Fault tolerance testing (sometimes called stimulus/response testing or stress testing) is used to ensure that a network responds correctly to various fault conditions. Though there are many additional fault conditions you can test with the CTS850, this section covers three common examples:

- Response to errors and alarms
- Response to pointer movements
- Response to line frequency offset

Response to Errors and Alarms

This example uses two CTS850 testers to simultaneously check the upstream and downstream responses to an error or alarm condition. You can use a single CTS850 to do the same thing by alternately

connecting the upstream and downstream signals to the RECEIVE input.

Table 3–1 shows the responses expected from Line Terminating Equipment (LTE), such as an STM-4/STM-1 multiplex section terminating element, when presented with three possible error and alarm conditions.

Table 3–1: LTE Responses to Errors and Alarms

Transmitted Error or Alarm	Expected Upstream Response	Expected Down-stream Response
RS B1 Error	MS REI	*none*
MS AIS	MS RDI	AU AIS
HP RDI	*none*	HP RDI
LOS	MS RDI	AU AIS

1. Connect two CTS850s to an LTE as shown in Figure 3–4.

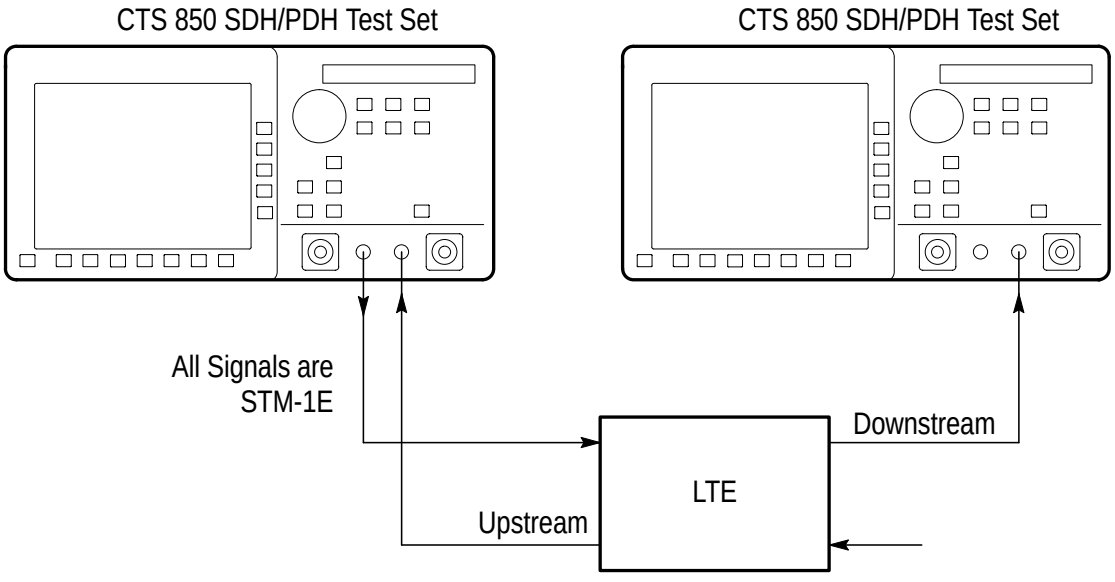


Figure 3–4: Setup to Check Error and Alarm Response

2. To check the LTE response to an RS B1 error, set up the upstream CTS850 as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	RECALL INSTRUMENT SETUPS	DEFAULT FACTORY SETTINGS	Recall Setup
TRANSMIT	TRANSMIT SETTINGS	Transmit Rate	STM-1E
		Tx/Rx Setup	Coupled
TRANSMIT	Defects & Anomalies	Error Type	RS B1
		Error Rate set to	1.0E–5
RESULTS	SDH RESULTS	*none*	SDH Anomalies

3. Set up the downstream CTS850 as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	RECALL INSTRUMENT SETUPS	DEFAULT FACTORY SETTINGS	Recall Setup
RECEIVE	RECEIVE SETTINGS	Receive Rate	STM-1E
RESULTS	SDH RESULTS	*none*	Defects

4. Press the **START/STOP** buttons on both the upstream and downstream CTS 850 units so that the START/STOP lights are on.

5. Verify that RS B1 BIP errors are counted in the SDH RESULTS display of the upstream CTS850.

6. Verify there are no errors counted in the SDH RESULTS display of the downstream CTS850.

7. Press the **START/STOP** buttons on both the upstream and downstream CTS850s so that the START/STOP lights are off.

8. To check the LTE response to an MS AIS alarm, change the upstream CTS850 as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	Defects & Anomalies	Error Rate set to	None
		Transmit Alarm set to	MS AIS
RESULTS	SDH RESULTS	*none*	SDH Defects

9. Change the downstream CTS850 as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
Results	Main Results	SDH Defects	*none*

10. Press the **START/STOP** buttons on both the upstream and downstream CTS850 units so that the START/STOP lights are on.

11. Verify that MS AIS alarm seconds are counted in the SDH RESULTS display of the upstream CTS850.

12. With the downstream CTS850, verify that the displayed K1 or K2 bytes are not all zeros.

13. Press the **START/STOP** buttons on both the upstream and downstream CTS850s so that the START/STOP lights are off.

14. To check the LTE response to a HP RDI alarm, change the upstream CTS850 as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	Defects & Anomalies	Error Rate set to	None
		Transmit Alarm set to	HP RDI
RESULTS	SDH RESULTS	*none*	Defects

15. Change the downstream CTS850 as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
RESULTS	SDH RESULTS	*none*	Anomalies

16. Press the **START/STOP** buttons on both the upstream and downstream CTS850 units so that the START/STOP lights are on.

17. Verify that the HP RDI light is on, on the downstream CTS850.

Response to Pointer Movements

Pointers allow the SDH network to multiplex signals from independent sources, even if the signal clock rates differ slightly from each other. Within the allowed range, pointer movements should have no adverse affect on the performance of the network.

This example transmits a signal with frequent pointer movements to an NE and checks that the downstream signal is error free.

1. Connect the CTS850 to an NE as shown in Figure 3–5.

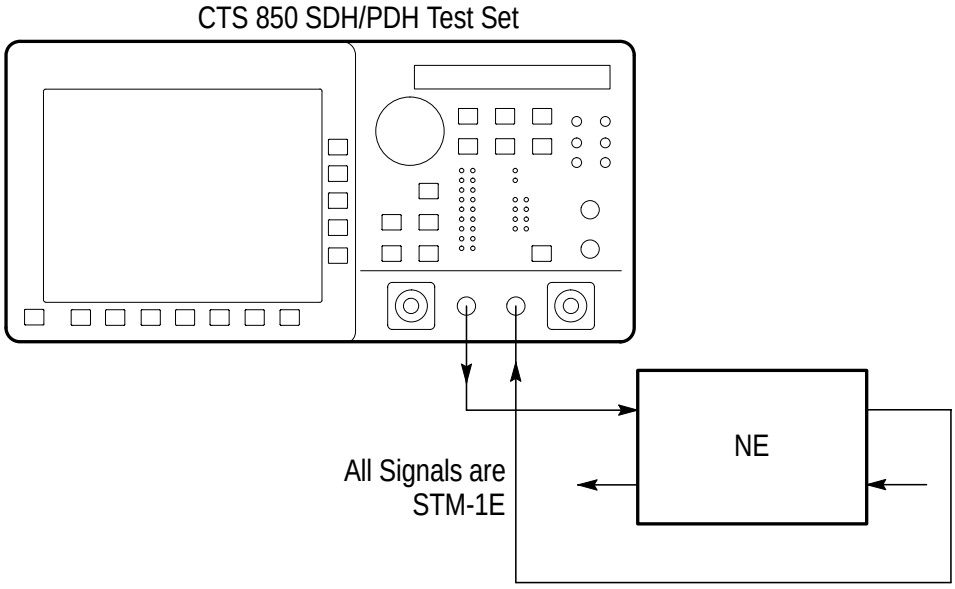


Figure 3–5: Setup to Check Pointer Movements

2. Set up the CTS850 as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	RECALL INSTRUMENT SETUPS	DEFAULT FACTORY SETTINGS	Recall Setup
TRANSMIT	TRANSMIT SETTINGS	Transmit Rate	STM-1E
		Tx/Rx Setup	Coupled
TRANSMIT	POINTERS & TIMING	Pointer Control	Continuous
RESULTS	SDH RESULTS	*none*	Defects

3. Press the **START/STOP** button on the CTS850 so that the START/STOP light is on.

4. Verify that there are no errors in the SDH RESULTS display. When the front-panel ERROR light is not on, it also indicates there are no errors in the received signal.

5. To check for received pointer movements, change the CTS850 setup as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
RESULTS	SDH RESULTS	*none*	Pointers

6. Verify that the CTS850 is counting positive pointer justifications. Depending on the clock rate of the NE, some negative pointer justifications are also possible.

Response to Line Frequency Offset

Pointers also accommodate differences in line frequency from one NE to another. In this example, the CTS850 transmits a signal at an offset line frequency to an NE and measures the response.

1. Connect the CTS850 to an NE as shown in Figure 3–6.

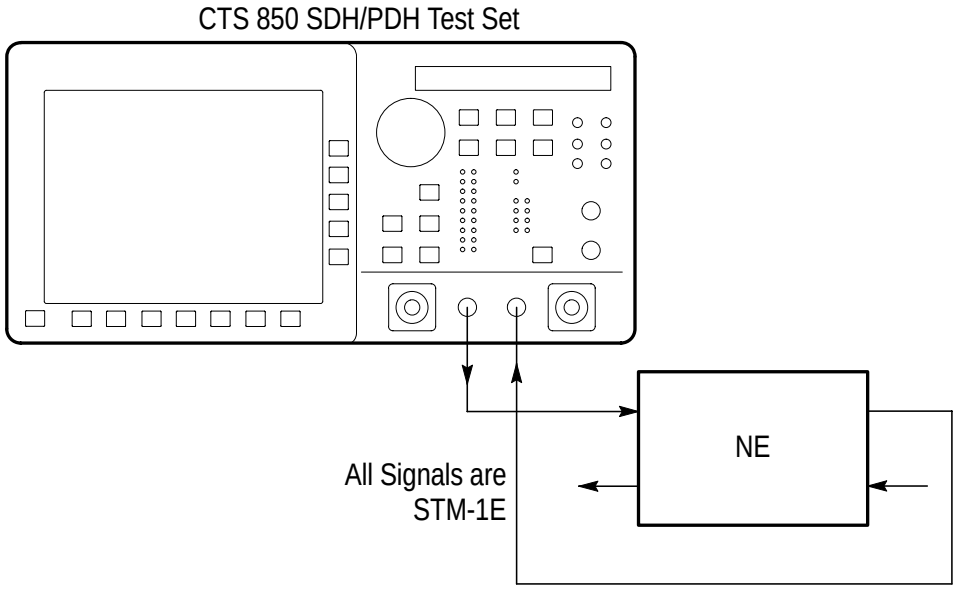


Figure 3–6: Setup to Check Line Frequency Offset Response

2. Set up the CTS850 as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	RECALL INSTRUMENT SETUPS	DEFAULT FACTORY SETTINGS	Recall Setup
TRANSMIT	TRANSMIT SETTINGS	Transmit Rate	STM-1E
		Tx/Rx Setup	Coupled
TRANSMIT	POINTERS & TIMING	Pointer/Timing Mode	Frequency Offset
		Offset Mode	Line
		Frequency Offset	Stress +4.6 ppm
RESULTS	SDH RESULTS	*none*	Network Defects Section Defects Path Defects

3. Press the **START/STOP** button on the CTS850 so that the START/STOP light is on.

4. Verify that there are no errors in the SDH RESULTS displays. When the front-panel ERROR light is not on, it also indicates there are no errors in the received signal.

5. To check that the NE is generating pointer movements, change the CTS850 setup as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
RESULTS	SDH RESULTS	*none*	Pointers

6. Verify that negative pointer justifications are being counted.

Performance Monitoring

When a new line is installed you may want to monitor performance for a day or so to be sure it is operating correctly. Or, if problems are suspected on a line, you may want to run a long test to determine the cause of the problem. In either case, the CTS850 makes it easy to monitor an electrical or optical line without the need for splitters.

During a test, the CTS850 simultaneously takes all performance measurements, analyzes the results according to the G.821 standard, and displays the measurements and analysis in your choice of three formats:

- In a brief summary
- In detail by type (defect, anomaly, alarm, failure)
- In detail by layer (regenerator section, multiplexer section, path)

In this example, the CTS850 is placed directly in line with a live optical signal to monitor performance in an unintrusive mode (Through Mode).

1. Connect the CTS850 in line with an optical signal as shown in Figure 3–7.

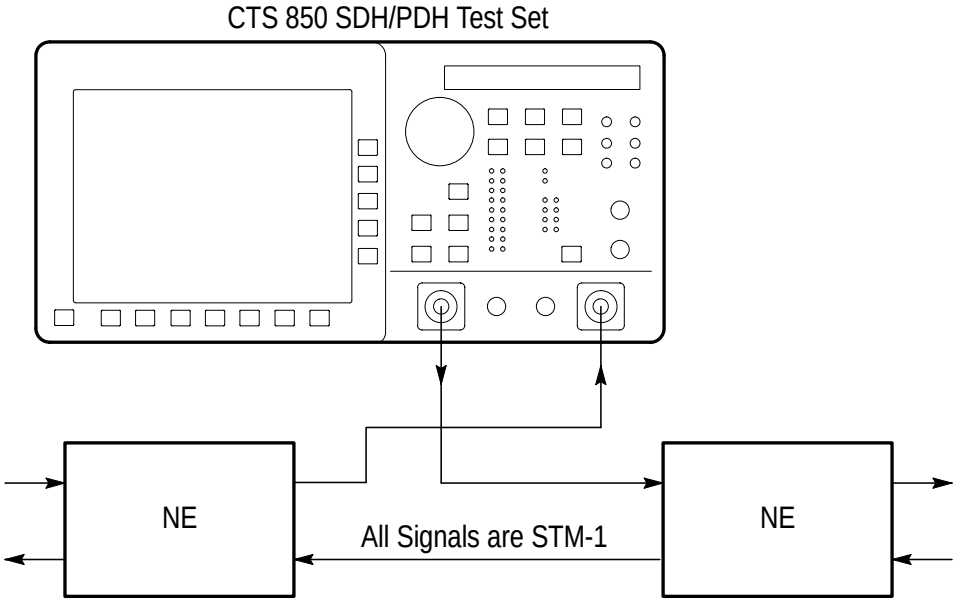


Figure 3–7: Setup to Monitor Performance

2. Set up the CTS850 as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TEST SETUPS	RECALL INSTRUMENT SETUPS	DEFAULT FACTORY SETTINGS	Recall Setup
RECEIVE	RECEIVE SETTINGS	Receive Rate	STM-1
TRANSMIT	TRANSMIT SETTINGS	Tx/Rx Setup	Through Mode
RESULTS	ERROR ANALYSIS	*none*	SDH – G.821 Analysis

3. Press the **START/STOP** button on the CTS850 so that the START/STOP light is on.

4. As the test is running, the analysis of Regenerator Section errors continually updates. You can also look at the analysis of

Multiplexer Section, Path, or Payload errors by pressing the buttons corresponding to those choices.

5. To see network performance data since the start of the test presented in graphical form, change the CTS850 setup as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
RESULTS	HISTORY GRAPHS	*none*	*none*

6. The CTS850 history coverage is based on storage interval which is determined by TEST SETUP. You can choose history graphs of the measured performance indicators in the following categories:

- Error count (any error you choose)
- Errored seconds (any error you choose)
- Pointer justifications
- Pointer value
- All failures
- All alarms

7. For example, to change the bottom graph to display the history of Path B3 Errored Seconds, change the CTS850 setup as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
RESULTS	HISTORY GRAPHS	*none*	Change Bottom
		turn the knob to select the desired graph	Path B3 Errored Secs
			Select Graph

8. Turning the knob moves the cursor from one bar to the next. The specific measurement values at the cursor location are shown in the display.

9. Once the graph fills the width of the display, you can pan through the entire test using the knob.

10. You can compress or expand the time scale with the Zoom Out or Zoom In action buttons. Press the button next to Zoom Out to change the time scale to 5 minutes per bar.

Jitter/Wander Testing

With the CTS850 jitter generation and analysis capability, it is easy to run the following automated ITU jitter conformance tests:

- Jitter Tolerance
- Jitter Transfer
- Output Jitter (Jitter Generation)
- Pointer Jitter

This section shows examples of the jitter tolerance, jitter transfer and video timing quality tests.

Testing Jitter Tolerance

The CTS850 generates a signal that contains jitter at various frequencies and feeds it to the network element. Simultaneously, the CTS850 receives the output from the network element and analyzes its performance.

You can specify several parameters for the test:

- Mask type for jitter analysis
- Start frequency
- End frequency
- Number of frequency samples
- Tolerance criteria

The results are displayed in numerical and graphical form.

The CTS850 provides two methods to measure the tolerance of a network element to jitter applied at its input:

- Onset-of-errors method
- 1 dB power penalty (BER) method

These methods are fully specified and described in the ITU-T Recommendation O.171 test set standard.

Onset-of-Errors Method. The onset-of-errors method measures the error output of a network element when jitter is applied to its input. If there are two or more Errored Seconds in a 30-second time interval, then the CTS850 plots the jitter frequency and amplitude on a graph and compares it to a mask you can choose.

1. Connect the CTS850 to the network element as shown in Figure 3–8.

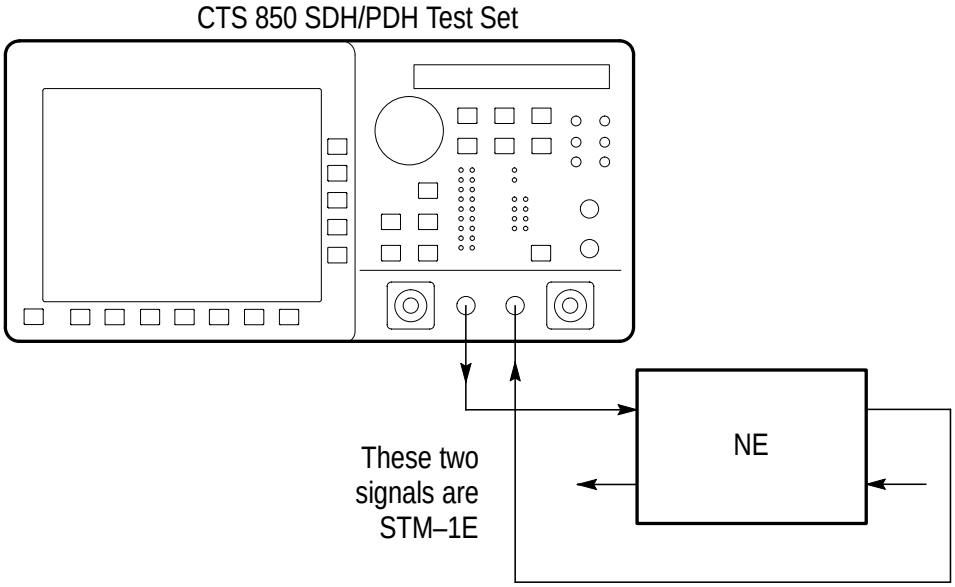


Figure 3–8: Setup to Check Onset-of-Errors Jitter Tolerance

2. Set the transmit and receive signals to STM-1E.

3. Set up the CTS850 as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	JITTER & WANDER	Output Jitter	Line
TEST SETUPS	JITTER TESTS	Test Type	Jitter Tolerance
		Test Control	Edit Setup
		Mask Type	*as appropriate*
		Start Frequency	*as appropriate*
		End Frequency	*as appropriate*
		Number Freq Samples	*as appropriate*
		Tolerance Criteria	Onset of Errors

4. Press the **START/STOP** button on the CTS850 so that the START/STOP light is on.

As the test is running, the jitter tolerance graph is displayed on the screen. The results of each frequency point will also be displayed. The test stops automatically after it has completed. The CTS 850 will also display whether the test passed or failed.

1 dB Power Penalty Method. The 1 dB power penalty method uses the BER to measure the amount of jitter that is equivalent to a 1 dB loss of signal power at the optical input of a network element.

1. Connect the CTS850 to the network element as shown in Figure 3–9.

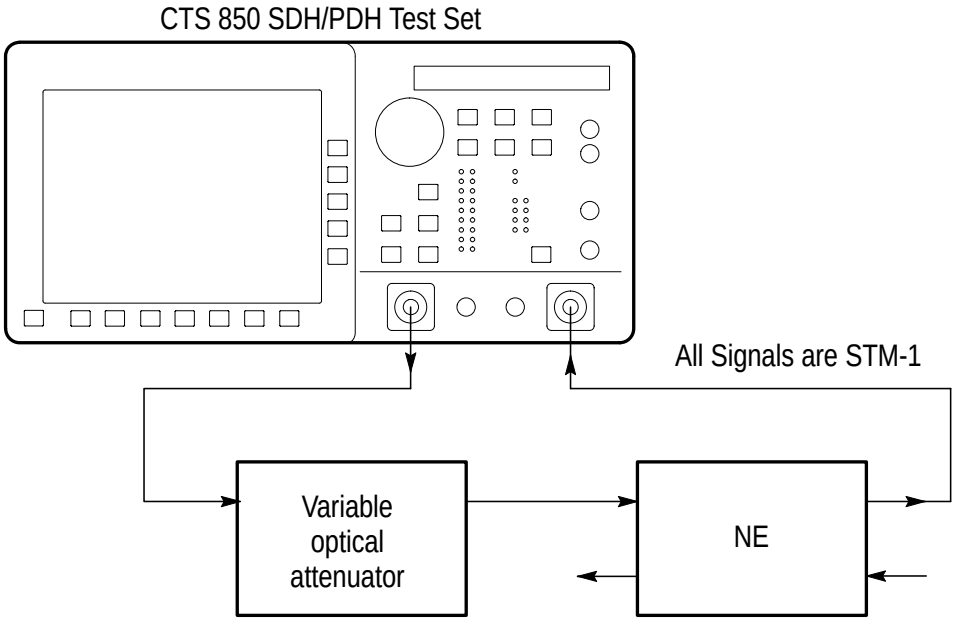


Figure 3–9: Setup to Check 1 dB Power Penalty Jitter Tolerance

2. Set up the CTS850 as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	JITTER & WANDER	Jitter Output	Line
TEST SETUPS	JITTER TESTS	Test Type	Jitter Tolerance
		Test Control	Edit Setup
		Mask Type	*as appropriate*
		Start Frequency	*as appropriate*
		End Frequency	*as appropriate*
		Number Freq Samples	*as appropriate*
		Tolerance Criteria	BER
		Record Error Threshold	Measure BER

3. 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.

4. When the Current BER exceeds the Recommended BER:

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

5. Reduce the optical attenuation by 1 dB.

6. Press the **START/STOP** button on the CTS850 so that the START/STOP light is on.

The CTS850 applies progressively increasing jitter to the input until the Current BER reaches the threshold you set. At that time, the test stops automatically and the results are displayed.

Testing Clock-to-Line Jitter Transfer

This test measures the transfer function for jitter in the output of a network element relative to jitter in its clock. The CTS850 generates a 2 MHz G.703 clock signal containing jitter that is connected to the network element. The CTS850 also generates a jitter-free test pattern connected to the input of the network element. Then, the CTS850 receives the output from the network element and analyzes its performance.

You can specify several parameters for the test:

- Mask type for jitter analysis
- Start frequency
- End frequency
- Number of frequency samples

The results are displayed in numerical and graphical form.

1. Connect the CTS850 to the network element as shown in Figure 3–10.

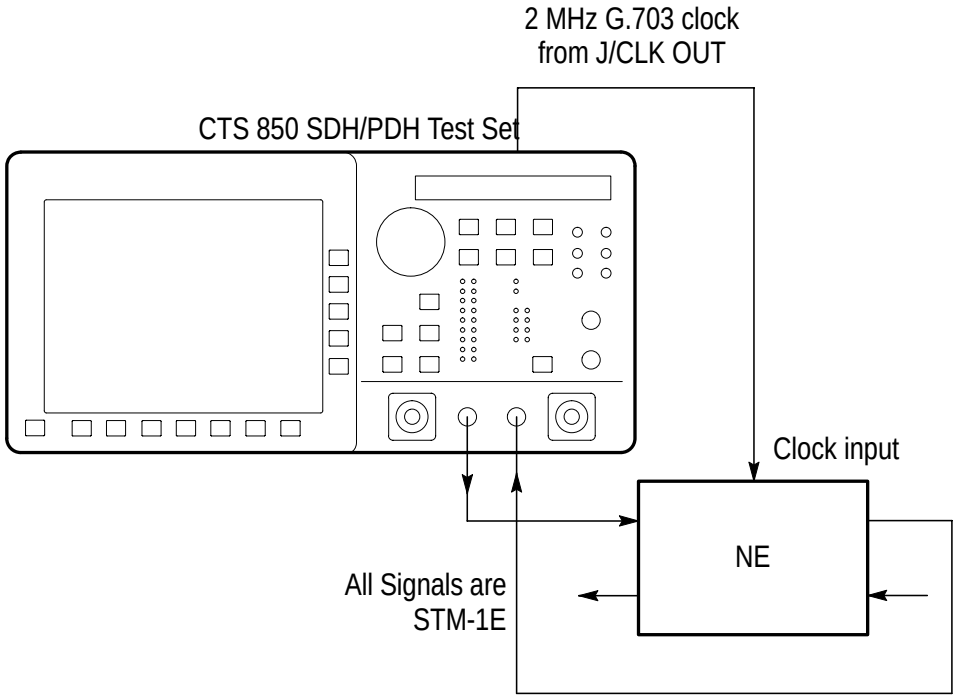


Figure 3–10: Setup to Check Clock-to-Line Jitter Transfer

2. Set up the CTS850 as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	JITTER & WANDER	Jitter Output	MHz G.703
RECEIVE	JITTER & WANDER	Jitter Input Source	Line
TEST SETUPS	JITTER TESTS	Test Type	Jitter Transfer
		Test Control	Edit Setup
		Mask Type	*as appropriate*
		Start Frequency	*as appropriate*
		End Frequency	*as appropriate*
		Number Freq Samples	*as appropriate*

3. Press the **START/STOP** button on the CTS850 so that the START/STOP light is on.

As the test is running, the jitter transfer graph is displayed on the screen. The test stops automatically after it has completed.

Video Timing Quality Testing

Compressed digital video signals transmitted over a network can be impaired by low-frequency jitter or frequency drift that may be acceptable in other applications. One source of this jitter is pointer movement used to synchronize SDH payloads across a network. You can use the CTS850 to analyze jitter in a PDH signal due to pointer movement in the SDH signal. Two new measurements, Frequency Drift Rate and Pointer Hit Seconds, help show this effect.

The CTS850 generates a SDH signal containing a sequence of pointer movements. The CTS850 analyzes the timing of the dropped 34 Mb/s signal.

1. Connect the CTS850 to the network element as shown in Figure 3–11.

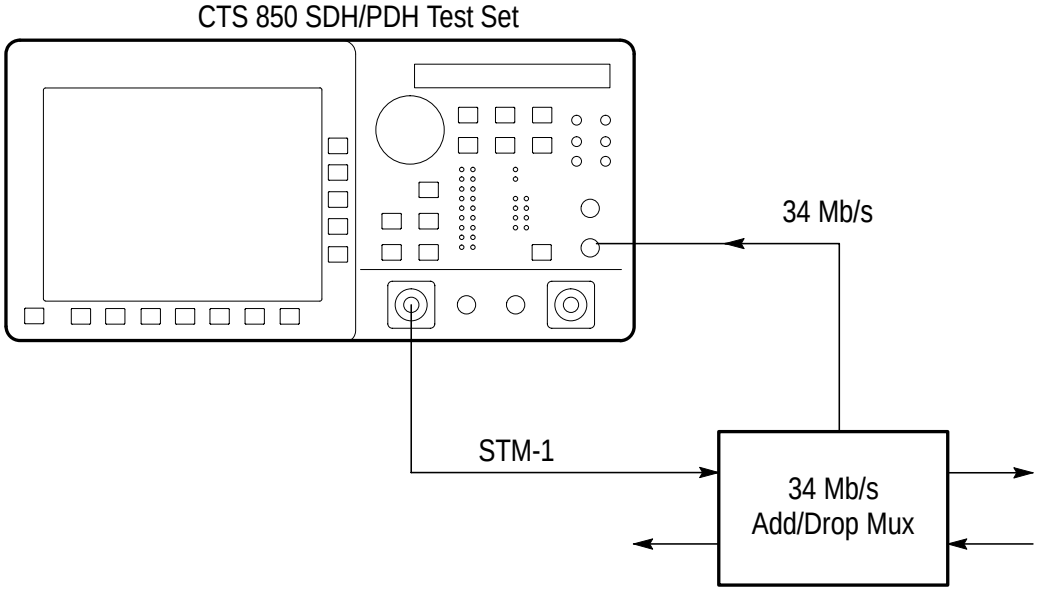


Figure 3–11: Setup to Check Video Timing Quality

2. Set up the CTS850 as follows:

Press Menu Button	Select Menu Page	Highlight Parameter	Select Choice
TRANSMIT	TRANSMIT SETTINGS	Transmit Rate	STM-1E
		Structure	TU3 Async
TRANSMIT	JITTER & WANDER	Jitter Output	Line
TRANSMIT	POINTERS & TIMING	Pointer/Timing Mode	Pointer Sequences
		Pointer Type	AU Pointer
		Sequence Type	Periodic 87–3
RECEIVE	RECEIVE SETTINGS	Receive Rate	34 Mb/s
RESULTS	SDH RESULTS	*none*	Jitter

3. Press the **POINTER ACTION** button to start the pointer sequence.

4. Press the **START/STOP** button on the CTS850 so that the START/STOP light is on.

As the test is running, results are displayed on the screen. The test stops automatically after it has completed.

Navigation – CTS 850 paper–based manual & CD–ROM

There is a deliberate gap between *Basic Testing*, which ends on page 3–32, and the next section *Jitter & Wander*, which begins on page 3–155.

In order to get you going as fast as possible with the CTS850 SDH/PDH Test Set, the paper–based user manual focuses solely on Getting Started information. User information, in as complete detail as required, is contained on the Reference CD–ROM.

The following table shows you where to quickly find the section that answers your particular test & measurement questions.

Everything else appears in the reference manual on CD–ROM, including all information contained in the paper–based user manual.

Where to Find Information in this User Manual

If you want to know how to:	Look in this part of the manual:
Use the basic functions of the test set, including – Controls, indicators, connectors; Elements of front panel display; Menu structure; Online help; Connecting signals; Selection and editing of choices; Disk drive operation	*Functional Overview,* Chapter 2 (paper–based and reference manual–on–CD)
Tutorial	*Tutorial,* Chapter 2
Setup and use the test set for network and equipment test applications, including – * Network continuity checking * Transmission signal quality testing * Fault tolerance testing * Performance monitoring * Jitter and wander testing * Video timing quality testing	*Basic Test Procedures,* Chapter 3 (paper–based and reference manual–on–CD)

Where to Find Information in this User Manual (Cont.)

If you want to know how to:	Look in this part of the manual:
Set TX (SDH, PDH) (reference manual–on–CD only)	
Set transmit rate; specify the AU under test; set the payload mapping and content; and set the overhead bytes for SDH signals	*Setting SDH Transmit Parameters,* Chapter 3
Set transmit rate, transmit clock, line clock offset, payload, framing, test pattern, active channel and background pattern for PDH signals	*Setting PDH Transmit Parameters,* Chapter 3
Set RX (SDH, PDH) (reference manual–on–CD only)	
Set receive line rate; specify the AU under test; set payload mapping and content; check received optical signal power; view overhead bytes for SDH	*Setting SDH Receive Parameters,* Chapter 3
Set the receive rate, receive level, framing and test pattern for PDH signals	*Setting PDH Receive Parameters,* Chapter 3
Jitter/Wander – Set TX/RX, Work with Test Setups, Calibrate (paper–based and reference manual–on–CD)	*Setting Jitter/Wander Parameters,* Chapter 3
Set & Test Alarms, Errors, Pointers, Timing, APS (reference manual–on–CD only)	
Generate error conditions, set alarms, and simulate network failures	*Setting Alarms and Inserting Errors,* Chapter 3
Generate Automatic Protection Switching (APS) commands and view the network response	*Testing Automatic Protection Switching,* Chapter 3
Set the duration for a test, the resolution of test history, start and stop a test	*Setting Test Control Parameters,* Chapter 3
Save and recall instrument setups; Create and run pass/fail tests	*Working with Test Setups*, Chapter 3

Where to Find Information in this User Manual (Cont.)

If you want to know how to:	Look in this part of the manual:
Change date and time settings, printer settings, GPIB, RS–232 parameters. Run a self–test	*Changing Instrument Settings*, Chapter 3
View, Print, Save & Recall Measurements (reference manual–on–CD only)	
Monitor input signal for alarms, errors and failures, indicating current signal status, history of signal status	*Checking Signal Status*, Chapter 3
View, save, recall, and print test results	*Viewing Results*, Chapter 3
Appendices (reference manual–on–CD only)	
Review available menu choices; Navigate menus	*Menu Maps*, Appendix A
Interpret Status & Error Messages	*Status & Error Messages*, Appendix B
Review Default Factory Settings	*Default Factory Settings*, Appendix C
Check all Specifications	*Specifications*, Appendix D
Verify the test set functions properly	*Incoming Inspection Test*, Appendix E
Check examples of instrument setups, test results and pass/fail tests that can be loaded into the test set	*Example Disk Contents*, Appendix F
Explain Rear–Panel Connectors	*Rear–Panel Connectors*, Appendix G
Change Optical Port Connectors	*Changing Optical Port Connectors*, Appendix H
Pack for Shipment	*Packing for Shipment*, Appendix I

Where to Find Information in this User Manual (Cont.)

If you want to know how to:	Look in this part of the manual:
Review telecommunications technology used by the test set	*Telecommunications Technology*, Appendix J
Look up word meanings in Glossary; review ITU–T standards used by the test set	*Glossary and ITU–T Standards*

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:

- Jitter Tolerance
- Jitter Transfer
- Output Jitter
- 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.

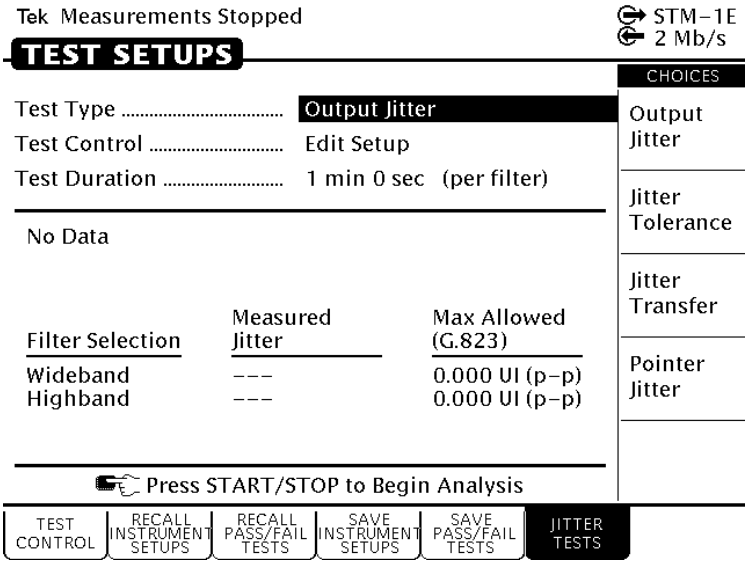


Figure 3–76: Example of TEST SETUP, Jitter & Wander screen

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.

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

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

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

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

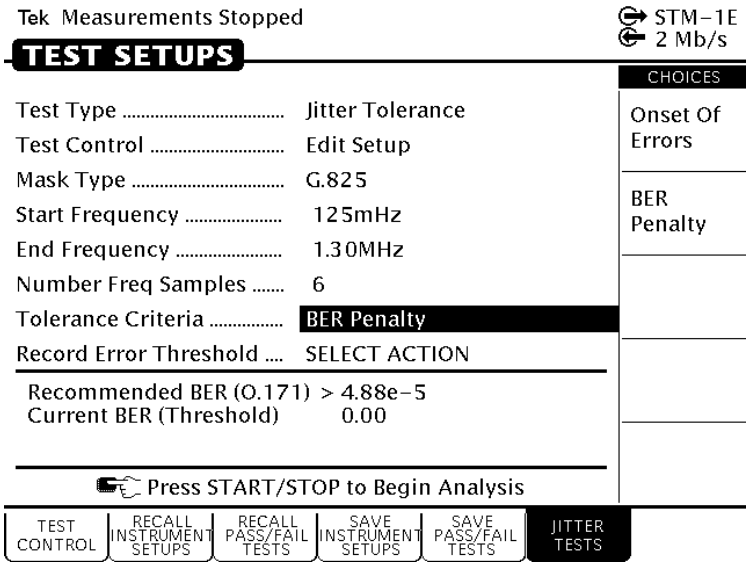


Figure 3–77: Example of TEST SETUP, Jitter Tests, BER Method

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

   - 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.

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.

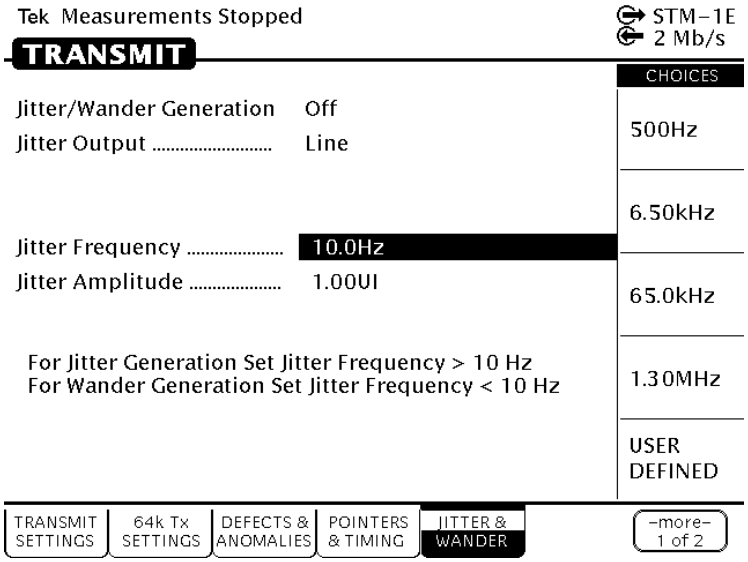


Figure 3–78: Example of TRANSMIT, Jitter menu

***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

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

- 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.
- 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.
- 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*

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*

- 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

- 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:

- Connect 2 MHz reference clock to 2 Mbps/ 2 MHz reference clock input on Rear Panel of test unit.
- Connect External 2 MHz clock to be measured to Jitter/ Clock input on Rear Panel of test unit.
- 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.
- Press Start/Stop twice to Start/Restart the test.
- For RESULTS, select the Jitter & Wander Screen, and view Wander Measurements.

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.

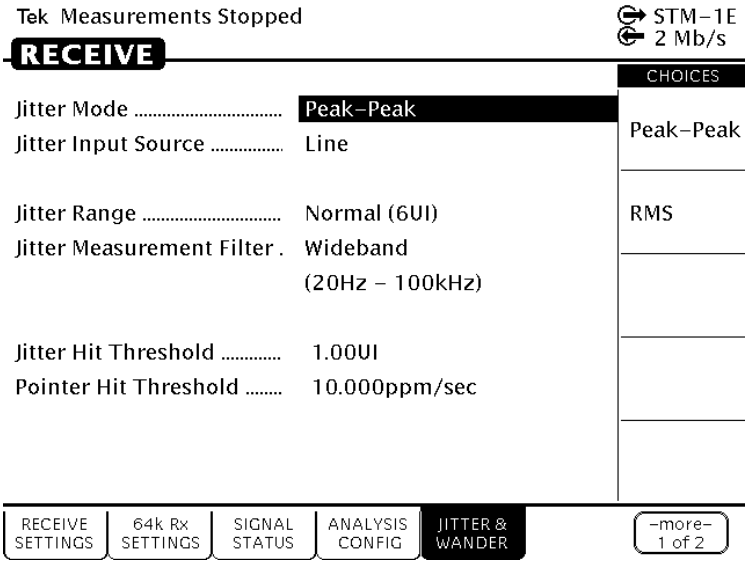


Figure 3–79: RECEIVE, Setting Jitter Mode, Peak–to–Peak

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

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

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

- 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).
- 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 3–80, 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.

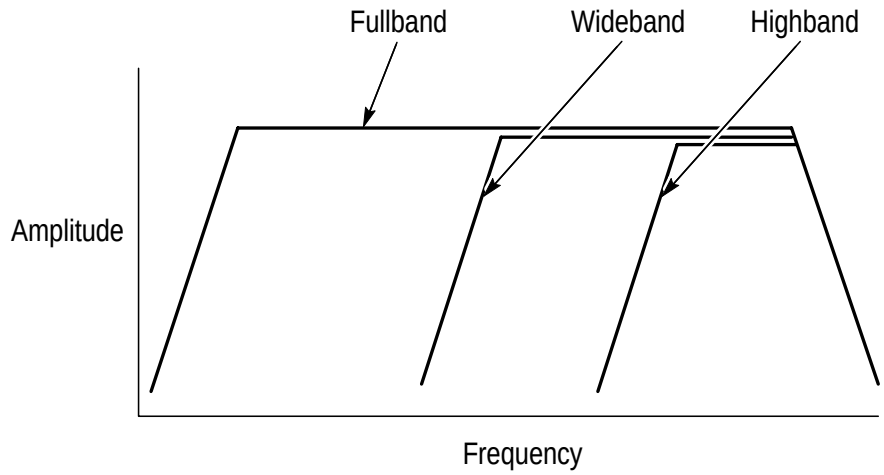


Figure 3–80: Jitter High–Pass Filters

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

- Select **Wideband** to measure jitter using the wideband measurement filter (500 Hz – 1.3 MHz).
- Select **Highband** to measure jitter using the highband measurement filter (65 kHz – 1.3 MHz).
- 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*

- 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*

- 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.

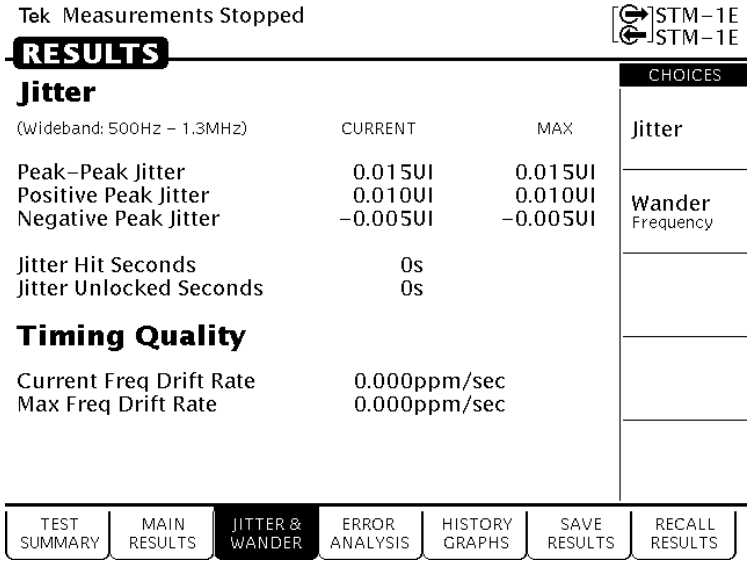


Figure 3–81: RESULTS, Jitter and Timing Quality

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.

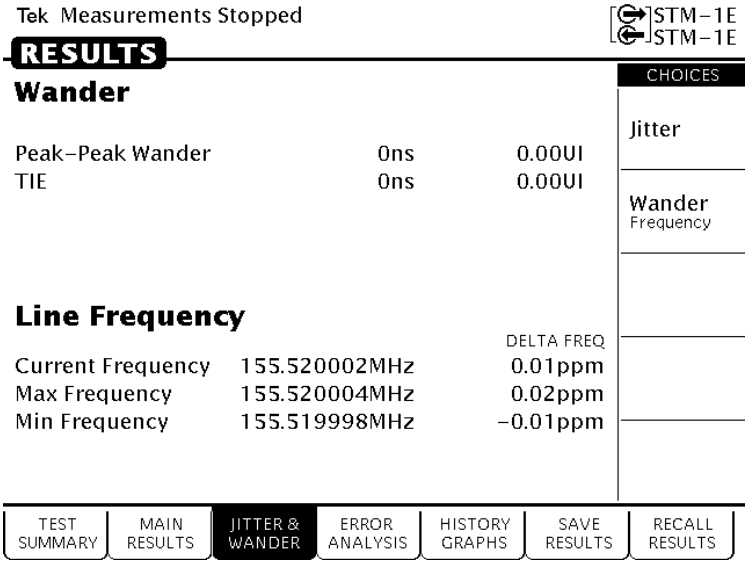


Figure 3–82: RESULTS, Wander and Line Frequency

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.

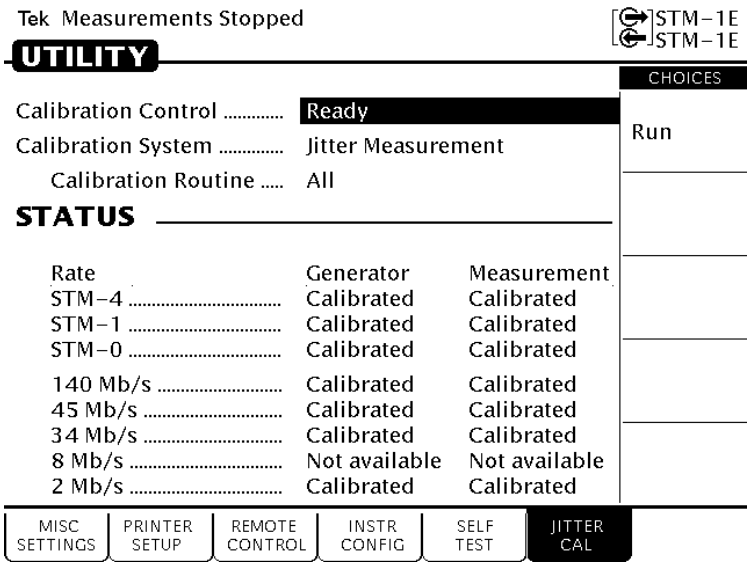


Figure 3–83: Example of UTILITY, Jitter Calibration

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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Check other sources for finding information within this CTS850 SDH/PDH Test Set user manual: Navigation of Manual table on page 1–4; Menu Maps beginning on page A–1; and, Table of Contents located in the front of the manual.

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