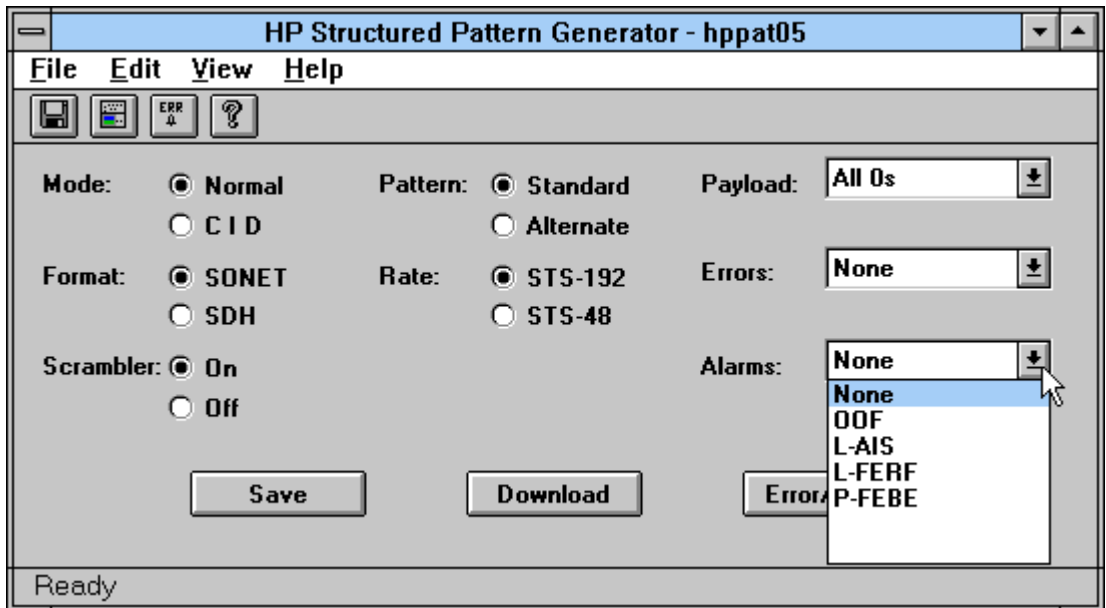


HP E4544A Sonet/SDH Structured Pattern Software

Operating Manual



©Copyright Hewlett-Packard-Limited 1999

All rights Reserved.

Reproduction, adaption, or translation without prior written permission is prohibited, except as allowed under copyright laws.

Publication number

E4544-90003

Printed in UK

Notice

The information contained in this document is subject to change without notice.

Hewlett-Packard makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties or merchantability and fitness for a particular purpose.

Hewlett-Packard shall not be liable for errors contained herein or for incidental damages in connection with the furnishing, performance, or use of this material.

This manual was produced using *Doc-To-Help*[®], by WexTech Systems, Inc.

Microsoft[®] is the U.S. registered trademark of Microsoft Corporation
Lotus[®] is the U.S. registered trademark of Lotus Development Corporation

Contents

About the HP E4544A Software	1
Overview	1
User Interface	3
Overview	3
Menu Bar	3
File:	3
Edit	4
View	4
Help	4
Tool Bar	4
Status Bar	4
Application Window	5
Mode	5
Pattern	5
Formats	5
Rates	5
Scrambler	6
Payload	6
Errors	6
Alarms	6
CID Block Length	6
Save	6
Download	7
The Error/Alarm key	7
To Make a Measurement	9
Introduction	9
Measurement Philosophy	9
HP Error Performance Analyzer Stimulus Capability	10
Introduction	10
Save to Disk Versus Download and Edit On-Line	10
Patterns	10
Normal Standard Pattern	10
Normal Alternate Pattern	11
CID Mode	11
Test Method	12
Equipment Configuration	12
To Download a Pattern	13

Standard Pattern Operation.....	13
Alternate Pattern Operation	13
To Edit an Alternate Pattern via the E4544A Front Panel.....	13
To Edit an Alternate Pattern On-Line Using an External Pulse Generator to Insert Errored Frames	14

Installation 15

Introduction	15
Equipment Required	15
Supported Computer.....	15
HP-IB Interface.....	15
To Install E4544A Sonet/SDH Structured Pattern Software.....	16
Troubleshooting.....	17
Support	17

Legal Information 19

Warranty	19
HP Software Product License Agreement.....	20

Reference 23

Introduction	23
Payload Details	23
Sonet Path Overhead and SDH HP Overhead Details.....	24
P-FEBE or HP-REL.....	24
P-BIP-8 B3 or HP-BIP-8 B3	24
Single B3 Error.....	24
P-AIS or HP-AIS	24
P-FERF or HP-FERF.....	25
All Other Path Overhead.....	25
Sonet Line Overhead and SDH MS Overhead Details.....	25
Pointer Bytes.....	25
L-AIS or MS-AIS	25
L-FERF or MS-FERF	25
L-BIP-8 B2 or MS-BIP-8 B2.....	25
SINGLE B2 ERROR	26
L-FEBE or MS-FEBE.....	26
ALL OTHER LINE OVERHEAD	26
SONET SECTION OVERHEAD AND SDH RS OVERHEAD DETAILS.....	27
S-BIP-8 B1 or RS-BIP-8 B1.....	27
SINGLE B1 ERROR	27
FRAMING.....	27
OUT OF FRAME	27
C1 CHANNEL IDENTIFICATION BYTES	27
ALL OTHER SECTION OVERHEAD.....	28
CID PATTERN DETAILS	28
Hewlett-Packard Sales and Service Offices	31

About the HP E4544A Software

Overview

The SONET/SDH Structured Pattern Software allows the construction of Sonet (STS-192, STS-48) frames or the equivalent SDH (STM-64, STM-16) frames, for use in the HP 71612A 12Gb/s and HP 71603B 3Gb/s Error Performance Analyzers.

Using the software, SONET/SDH logical and alarm testing can be performed on network element receiving equipment, using the HP instrument as the stimulus.

The software allows the specification of frames which are alarm and error free, or with selected alarms and errors. The errors and alarms are specified at the functional level, rather than by accessing bytes and bits directly. There is a choice of payload fill pattern, and an internal scrambler can be turned on or off.

The following features are provided:

Single Error per frame.....B1, or B2, or B3, or none

Any one AlarmOOF, L-AIS, L-FERF, P-FEBE, NONE (**Sonet**)
OOF, MS-AIS, MS-RDI, HP-REI, NONE (**SDH**)

Bulk Payloadall ones, all zeros, Alternate 1,0, PRBS 11, PRBS 15, PRBS 20, PRBS 23

Scrambler.....On / Off

The E4544A software allows a structured pattern (or frame) to be specified, and generated in a PC. The pattern can be written to a floppy disk, or direct to the HP Error Performance Analyzer via the HPIB.

Patterns on floppy disk can be loaded by the HP Error Performance Analyzer and used to generate the specified pattern.

Patterns, written to the HP Error Performance Analyzer via the HPIB .patterns can be edited “**on-line**” in the HP Error Performance Analyzer , which allows the alarm and error conditions to be changed much faster than the alternative method, of re-writing complete patterns.

During “**on-line**” edits, data generation from the HP Error Performance Analyzer will briefly interrupted.

On-line editing should only be used on patterns which were generated by the E4544A software and downloaded into the HP Error Performance Analyzer.

Manual editing of patterns generated by the E4544A software, using the HP Error Performance Analyzer screen editor, is not recommended. Manual editing may generate parity errors. (B1 B2 and B3 parity calculations are performed in the E4544A Structured Pattern Software).

User Interface

Overview

The Menu Bar, Tool Bar and keys within the application window are used to select main parameters and configure/construct Sonet or SDH patterns. Refer to the following sections for an explanation of each of the user interfaces.

Menu Bar



There are four selections on the Menu Bar , **File**, **Edit**, **View** and **Help**.

File:

Select from: **Save As**, **Download** or **Exit**.

Save As

The Save button opens up a File Save As sub-panel.

In normal usage files are saved to a floppy disk with a special file name, and include header information required by the HP Error Performance Analyzer; for example:

A:\hppat05.dat

A:\hppat06.dat

A:\hppat07.dat

A:\hppat08.dat

A:\hppat09.dat

A:\hppat10.dat

A:\hppat11.dat

A:\hppat12.dat

Files can be saved to any valid location, with any valid name.

A warning is generated if one of the special names is not used or if the file already exists.

Use of a non-special file name saves the file without the HP Error Performance Analyzer header.

Download

The Download button transfers a pattern to the instrument current pattern memory via the HP-IB.

Exit

Select **Exit** to exit the program.

Edit

Select from **HP-IB** or **Direct to Instrument**

HP-IB: Select this option if you wish set the instrument HP-IB primary addresses.

Direct to Instrument: Select this option to enter/exit the "edit on-line" function.

View

Select **Tool Bar** or **Status Bar** or both.

Help

Use this key to view revision information for the E4544A Sonet/SDH structured pattern software.

Tool Bar



.....Opens up the **File Save As** Sub-Panel.



.....Download a pattern to the selected Pattern Generator via HP-IB.



.....Enter/Exit the "edit on-line" function.



.....Use this key to view revision information for the E4544A Sonet/SDH structured pattern software.

Status Bar

Status Bar

To enable the status bar select **View** then **Status Bar**.

The fields on the status bar give information on the current pattern mode/selection.

Application Window

The following text illustrates and explains the user selectable functions and parameters within the E4544A Application window.

Mode

There are two Modes: **Normal** and **CID**.

Normal

Normal specifies a single frame of a Sonet signal or an SDH signal.

Normal mode has parameters: **Pattern, Format, Rate, Scrambler, Payload, Errors and Alarms.**

CID

CID specifies a Consecutive Identical Digit pattern.

CID mode has parameters: **Format, Rate** and **CID block length.**

Pattern

There are two pattern types: **Standard** and **Alternate**.

A **Standard** user pattern, which contains one pattern, and an **Alternate** user pattern, which contains two equal length patterns defined as Half A and Half B.

In the HP E4544A software a **Standard** user pattern contains 1 frame, with or without errors or alarms.

An **Alternate** user pattern contains 2 frames total, where: Alternate Half A contains 1 frame and Alternate Half B contains 1 frame, with or without errors or alarms.

Formats

Format selects either a Sonet signal or an SDH signal formats.

Rates

When Sonet is selected the rates available are: STS-192 (9.95328 Gb/s) or STS-48 (2.48832 Gb/s).

When SDH is selected the rates available are: STM-64 or STM-16.

The user must set the correct bit rate on the HP instrument (Error Performance Analyzer or 3Gb/s Pattern Generator/Error Detector) The correct rates are STS-192 (STM-64) = 9,953,280,000 Bits/sec and for STS-48 (STM-16) = 2,488,320,000 Bits/sec.

Scrambler

The Scrambler can be set to: **On** or **Off**.

The standard Sonet / SDH 2^7 PRBS is used.

Payload

The payload is user definable from:

All ones; All zeros; Alternate 1,0; PRBS 11; PRBS 15; PRBS 20; PRBS 23.

Errors

For Sonet, any one error type from: S-BIP (B1), L-BIP (B2), P-BIP (B3), NONE

For SDH, any one error type from: RS-BIP (B1), MS-BIP (B2), HP-BIP (B3), NONE

Alarms

For Sonet, any one error type from: OOF, L-AIS, L-FERF, P-FEBE, NONE

For SDH, any one error type from: OOF, MS-AIS, MS-RDI, HP-REI, NONE

CID Block Length

The Length of the block of consecutive identical digits can be set from 0 to 100 bytes; the default value is 9 bytes.

Save



Save displays the **File Save As** subpanel.

The pattern will contain a header as required by the HP Error Performance Analyzer, if one of the standard file names is used.

The pattern contents are as specified by the Mode, Pattern, Format, Rate, Scrambler, Payload, Errors, Alarms, and CID block length parameters.

Download



Download will write a pattern to the current user pattern memory via HP-IB.

The pattern contents are as specified by the Mode, Pattern, Format, Rate, Scrambler, Payload, Errors, Alarms, and CID block length parameters.

The HP Error Performance Analyzer will be returned to local control after the download has completed.

The first time this operation is performed in a session, a choice of instruments is given. The choices are:

HP 70843A 12 Gbit/s

HP 70841B 3 Gbit/s Pattern Generator

The Error/Alarm key



Use the Error/Alarm key to enter/exit the **edit on-line** subpanel.

A new error or alarm can be selected and will be sent immediately to the instrument after selection via HP-IB.

The HP Error Performance Analyzer will be returned to local control after each error or alarm change has completed.

This feature will exit when the Error/Alarm button is toggled again.

To Make a Measurement

Introduction

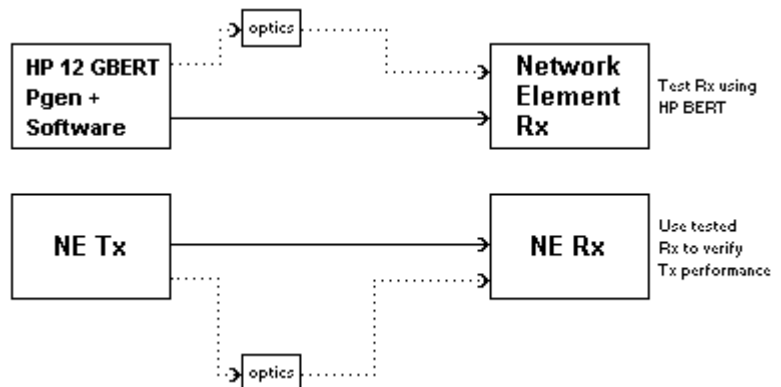
This chapter explains how the HP E4544A software can be used with an HP Error Performance Analyzer to test SONET/SDH Network Elements.

Measurement Philosophy

Use an HP Pattern Generator (HP 70841B or HP 70843A) as a SONET/SDH data signal stimulus to test a Network Element Receiver. The Network Element (NE) Receiver can be tested for response to alarms and errors.

A tested NE Receiver can then be used to test the NE Transmitter.

Tests can be performed at the electrical interfaces directly with an HP Error Performance Analyzer, or at optical interfaces by adding suitable optics. The following figure illustrates an OC-192 Functional Test Strategy using an HP Bit Error Rate Test Set (BERT).



HP Error Performance Analyzer Stimulus Capability

Introduction

Note the following text assumes that you are using an HP Error Performance Analyzer and are familiar with the configuration and setup of such a system.

Save to Disk Versus Download and Edit On-Line

All of the possible pattern configurations available with the E4544A software can be either :

- a) saved to disk (for later loading into the pattern generator) or
- b) downloaded directly to the pattern generator via an HP-IB link.

The test descriptions which follow in this section assume that patterns will be downloaded over HP-IB. However the same tests can be performed using disk patterns but will require many different pattern configurations to be saved to disk in advance and consequently a new disk pattern to be loaded for each test. Because of the relatively slow speed of disk-based operation, testing using disk patterns will take considerably longer.

The other advantage of downloading over HP-IB is the ability to edit on-line the downloaded patterns which makes changing error/alarm conditions between tests much faster than re-loading the entire pattern to the instrument. For example to change from B1 errors to B2 only a small part of the pattern already loaded into the instrument needs to be re-programmed; edit on-line downloads only those parts of the pattern which have changed.

Patterns

There are three basic modes of operation of the E4544A software, Normal **Standard** patterns, Normal **Alternate** patterns and **CID** patterns.

Normal Standard Pattern

In Standard mode a single SONET/SDH frame is generated at the chosen rate. The frame can be generated with or without errors/alarms.

Generally a frame without errors or alarms would initially be downloaded and used to verify error/alarm free operation of the device under test. Then using the edit on-line function the errors/alarms would be individually selected and the DUT checked for the expected response. Combinations of errors/alarms can also be tested.

In this mode the errors and or alarms are continuous (that is, if B1 error is selected then there will one error in every frame or 8000 errors per

second); this mode is therefore used to verify that the DUT basic functionality exists.

Normal Alternate Pattern

In Alternate mode two SONET/SDH frames are generated at the chosen rate. The pattern generator will automatically be switched into its alternate pattern mode when these frames are downloaded. In this mode the pattern generator partitions its memory into two halves (Half A and Half B) and will transmit the pattern from only one of the halves (as specified by the user).

The E4544A software will load a single frame into each half of the pattern generator memory (the frame in Half a will always be set to error/alarm free, whilst the frame in Half B will contain the selected choice of errors/alarms).

In Alternate Pattern mode runs of error free frames (Half A) can be interspersed with one or more errored/alarmed test frames (Half B) in any sequence, either from the Pattern Generator front panel or by using an external Pulse Generator connected to the Error Performance Analyzer AUX INPUT. Figure 1 gives a hook-up diagram for this type of operation and illustrates an example of the type of pulse required at the AUX INPUT.

Generally Half A (error/alarm free) frames will be transmitted to obtain correct operation of the DUT; and then one or more Half B frames transmitted to test the dynamic response of the device under test, for example:

- a) single injections of Half B frame with B1 errors set should register a single B1 error count on the DUT.
- b) inserting 1 to 3 frames of Half B set to OOF alarm should not register an OOF alarm on the DUT, but inserting 4 or more frames will. Again using the edit on-line function the errors/alarms in Half B can be selected as required for each test.

CID Mode

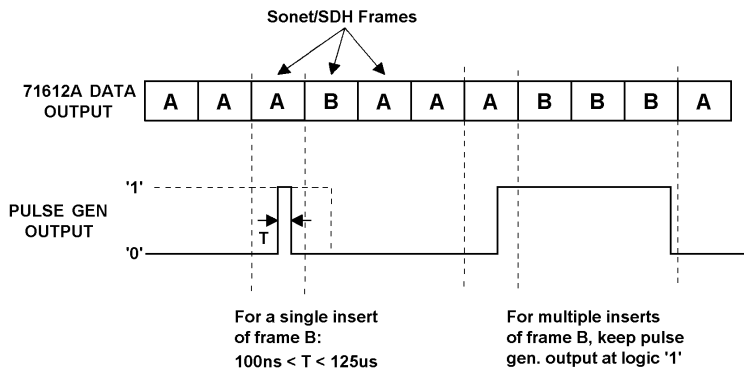
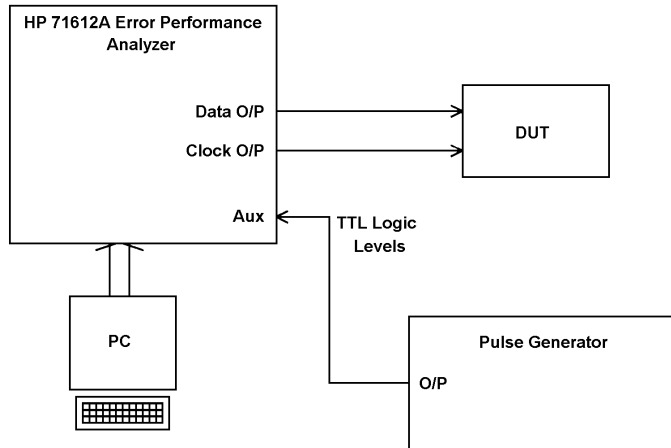
This mode will generate a single pattern (with length equivalent to a SONET/SDH frame at the chosen rate). The user can select the length (in bytes) of consecutive identical digits prior to downloading. There is no edit on line function for CID patterns.

Generally this type of pattern is used to stress test optical transmitters and receivers - particularly clock recovery circuits.

Test Method

Equipment Configuration

1. Connect up an HP Error Performance Analyzer, PC and Pulse Generator to the Device Under Test (DUT) as shown in the following Figure: (Figure 1 Equipment Configuration)



2. Install the E4544A software on your PC; instructions are given in the Installation chapter of the E4544A Users Manual.
3. Run the E4544A software by double clicking on the Pattern Generator icon in the HSBER program group on your PC.
4. Setup the Mode, Pattern, Format, Rate, Scrambler, Payload, Errors and Alarms as required on the E4544A software user panel.

To Download a Pattern

To download the pattern to the Error Performance Analyzer (select **File** then **Download** or just press the **Download** key.

Note that the first time a Download operation is performed a subpanel offering a choice of instruments is given. The choices are HP 70843A 12Gb/s and HP 70841B 3Gb/s Pattern Generators.

Standard Pattern Operation

If you selected a **Standard** (single) pattern in order to perform a static test, use the on-line edit features to introduce errors or alarms to test the response of the equipment under test. Use the **Error/Alarm** key to enter/exit the on-line editor.

Alternate Pattern Operation

You can stimulate the system under test with an Alternate Pattern from the Error Performance Analyzer front panel or by using an external Pulse Generator (see Figure 1).

To Edit an Alternate Pattern via the E4544A Front Panel.

Set your HP Error Performance Analyzer as follows:

If you are using an HP 71600B system (HP 70841B) select the following : **MENU**, **user pattern**, **ALT PAT CONTROL** and then select **SOURCE USR**.

If you are using an HP 71612A system (HP 70843A) select **MENU pattern** then select **ALT PAT USR**.

For a Single Insertion of Half B

On an HP 71612A system select **ALT PAT ONCE** and also **ALT PAT ONCE B**.

On an HP 71600B system select **OUTPUT ONCE** and **INSERT HALF B**.

For Continuous Transmission of Half A or Half B

On an HP 71612A system select **ALT PAT ALT** then **ALT PAT HALF A** (for continuous Half A) or **ALT PAT HALF B** (for continuous Half B).

On an HP 71600B system select **OUTPUT ALT** and **HALF A** or **HALF B** as required.

Monitor the response of the system under test to the added errors/alarms. Use the **Error/Alarm** key to enter/exit the on-line editor.

To Edit an Alternate Pattern On-Line Using an External Pulse Generator to Insert Errored Frames

Connect up the equipment as shown in Figure 1.

Enable the Auxiliary port as follows:

If you are using an HP 71600B system (HP 70841B) set the **SOURCE** function to **AUX**.

If you are using an HP 71612A system (HP 70843A) set the **ALTPAT** function to **AUX**.

For a Single Insertion of Half B

On an HP 71600B system select **OUTPUT ONCE**.

On an HP 71612A system select **ALT PAT ONCE**. The rising edge of the pulse from the Pulse Generator inserts one frame of Half B into Half A frames. The minimum pulse should be 100ns, see Figure 1 for an example of the pulse required.

To Insert One or More Half B Frames

On an HP 71600B system select **OUTPUT ALT**.

On an HP 71612A system select **ALT PAT ALT**.

Note that a logic "1" outputs Half B and a logic "0" Half A.

Setup the Pulse Generator to output a suitable pulse as shown in Figure 1. For more than one insertion of Half B increase the pulse width accordingly. For example to insert 2 frames ensure the pulse width is between 250 -375 us.

Start a measurement and observe how the system under test responds to the errors/alarms you selected in step 2. To introduce new errors/alarms on-line press the **Errors/Alarms** key and then edit errors and alarms and check how the system responds.

Installation

Introduction

This chapter provides information on the equipment required to run the HP E4544A Sonet/SDH Structured Pattern Software and how to install it. Simple troubleshooting is also given to aid the user should the application fail to operate correctly, and advice on where to obtain additional support.

Equipment Required

HP 70843A/HP71612A 12 Gbit/s Error Performance Analyzer.
HP 70841B/HP 71600 3 Gbit/s Error Performance Analyzer.

Supported Computer

The HP E4544A Sonet/SDH Structured Pattern Software is designed to run on IBM-PC/AT, or 100% compatible, PC or Laptop running Microsoft Windows 95 or Microsoft Windows NT.

The recommended and supported PC options are:

HP 100MHz Pentium PC with at least 8 Mbytes of memory and an HP 82341C interface.

The HP E4544A application software is supplied on one 3.5in floppy disk.

HP-IB Interface

Control of the HP 70843A from the computer is via the IEEE.488 interface (HPIB).

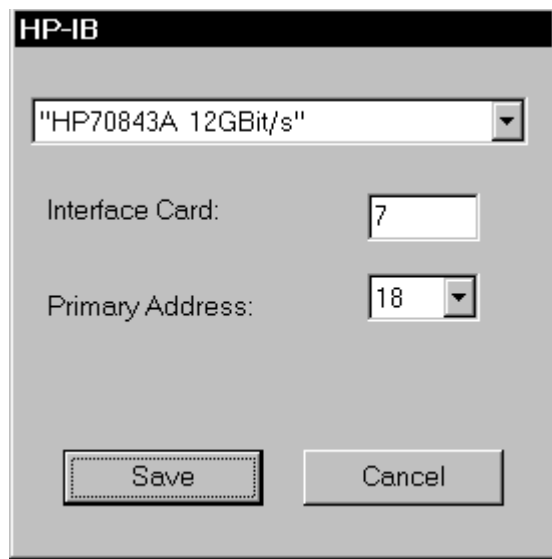
The HP standard Instrument Control Library (SICL) is used as the interface between the application software and the HPIB hardware.

Note: HP SICL does not form part of the HP E4544A product and must be installed separately before the application can run.

Note: The HP E4544A software will run on a PC that does not have SICL Drivers/HPIB Interface, but in this case will only enable patterns to be saved to disk (which can then be loaded into the Error Performance Analyzer).

The recommended interface is the HP 82341C.

To Setup the HPIB Address



Click on the HPIB tab and then select the Primary address for the instrument selected.

For Interface Cards set to a select code other than 7 (default), change the "7" in the Interface Card text box to the required number.

Default HPIB Primary Addresses are as follows:

HP 70843A/B - 18; HP 70340A - 19.
HP 70841B - 18, HP 70842B - 17.
HP 70311A - 19.

To Install E4544A Sonet/SDH Structured Pattern Software

1. Run Windows Explorer.
2. Insert disk 1 into the "A" floppy disk drive.
3. In **File Manager** select drive "A".
4. Select and run file "setup.exe".
5. Follow the installation instructions that appear on your screen after installation.
6. To run the software click on the shortcut which has been created under the Windows/Start/Programs Menu.

7. To run the help file double click the Pattern Generator Help icon in the HP-HSBER program group.

Troubleshooting

If the E4544A application software is not operating properly or not at all, carry out the following procedure:

1. Check that the HP Error Performance Analyzer is powered up correctly.
2. Check that the HP and PC HPIB ports are cabled together
3. Check that the HPIB card installed in your PC is configured correctly. Use the I/O Config Utility in the HP SICL program group.

Support

If you need any further help, please contact your nearest Hewlett-Packard service center or fax details to HP's Product Support department:

+44 131 331 7488.

Legal Information

Warranty

Software: HP warrants for a period of 90 days from the date of purchase that the software product will execute its programming instructions when properly installed on the personal computer or workstation indicated on this package. HP does not warrant that the operation of the software will be uninterrupted or error free. In the event that this software product fails to execute its programming instructions during the warranty period, Customer's remedy shall be to return the diskette(s) or tape cartridge(s) ("media") to HP for replacement. Should HP be unable to replace the media within a reasonable amount of time, Customer's alternate remedy shall be a refund of the purchase price upon return of the product and all copies.

Media: HP warrants the media upon which this product is recorded to be free from defects in materials and workmanship under normal use for a period of 90 days from the date of purchase. In the event any media prove to be defective during warranty period, Customer's remedy shall be to return the media to HP for replacement. Should HP be unable to replace the media within a reasonable amount of time, Customer's alternate remedy shall be a refund of the purchase price upon return of the product and all copies.

Notice of Warranty Claims: Customer must notify HP in writing of any warranty claim not later than thirty (30) days after the expiration of the warranty period.

Limitation of Warranty: HP makes no other express warranty, whether written or oral, with respect to this product. Any implied warranty of merchantability or fitness is limited to the 90-day duration of this written warranty. Some states or provinces do not allow limitations on how long an implied warranty lasts, so the above limitation or exclusion may not apply.*

This warranty gives specific legal rights, and you may also have other rights which vary from state to state, or province to province.

Exclusive Remedies: The remedies provided above are Customer's sole and exclusive remedies. In no event shall HP be liable for any direct, indirect, special, incidental, or consequential damages (including lost

profit) whether based on warranty, contract, tort, or any other legal theory. Some states or provinces do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Warranty Service: Warranty service may be obtained from the nearest HP sales office or other location indicated in the owner's manual or service booklet.

* UK only: if you are a "customer" as defined by statutes, parts of this statement may not apply to you.

HP Software Product License Agreement

Important: Please carefully read this license Agreement before opening the media envelope or operating the equipment. Rights in the software are offered only on the condition that the Customer agrees to all terms and conditions of the License Agreement. Opening the media envelope or operating the equipment indicates your acceptance of these terms and conditions. If you do not agree to the License Agreement, you may return the unopened package for a full refund.

License Agreement

In return for payment of the applicable fee, HP grants the Customer a license in the software, until terminated, subject to the following:

Use

Customer may use the software on any one computer.

Customer may not reverse assemble or decompile the software.

Copies and Adaptations

Customer may make copies or adaptations of the software:

For archival purposes, or

When copying or adaptation is an essential step in the use of the software with a computer so long as the copies and adaptations are used in no other manner.

Customer has no rights to copy unless they acquire an appropriate license to reproduce which is available from HP for some software.

Customer agrees that no warranty, free installation, or free training is provided by HP for any copies or adaptations made by Customer.

All copies and adaptations of the software must bear the copyright notice(s) contained in or on the original.

Ownership

Customer agrees that they do not have any title or ownership of the software, other than ownership of the physical media.

Customer acknowledges and agrees that the software is copyrighted and protected under the copyright laws.

Customer acknowledges and agrees that the software may have been developed by a third party software supplier named in the copyright notice(s) included with the software, who shall be authorized to hold Customer responsible for any copyright infringement or violation of this License Agreement.

Transfer of Rights in Software

Customer may transfer rights in the software to a third party only as part of the transfer of all their rights and only if Customer obtains the prior agreement of the third party to be bound by the terms of the License Agreement.

Upon such transfer, Customer agrees that the rights in the software are terminated and that they will either destroy their copies and adaptations or deliver them to the third party.

Transfer to a U.S. government department or agency or to a prime or lower tier contractor in connection with U.S. government contract shall be made only upon their prior written agreement to terms required by HP.

Sublicensing and Distribution

Customer may not sublicense the software or distribute copies or adaptations of the software to the public in physical media or by telecommunication without the prior written consent of HP.

Reference

Introduction

This chapter gives detailed specifications of the E4544A Payload, Overhead and Patterns.

Payload Details

The payload choices are:

All ones, All zeros, Alternate 1,0, PRBS 11, PRBS 15, PRBS 20, and PRBS 23.

Note the length of these PRBS, with respect to the two supported frame sizes:

The payload size of an STS-192 signal is:
1,188, 864 bits.

The payload size of an STS-48 signal is: 297, 216 bits.

PRBS Lengths

PRBS 11..... 2, 047 bits.

PRBS 15..... 32, 767 bits, this fits within an STS-48 frame.

PRBS 20..... 1, 048, 575 bits, this fits within an STS-192 frame.

PRBS 23..... 8, 388, 607 bits, (this exceeds the STS-192 frame size, but is included to provide some longer runs).

The polynomials are:

PRBS 11: $x^{11} + x^9 + 1$, inverted, taps as CCITT 0.152 but inverted.

PRBS 15: $x^{15} + x^{14} + 1$, inverted, as CCITT 0.151

PRBS 20 $x^{20} + x^{17} + 1$, inverted, taps as CCITT 0.151, but inverted.

PRBS 23 $x^{23} + x^{18} + 1$, inverted, as CCITT 0.151

The PRBS generators are initialized to all ones.

The PRBS runs continuously and will bulk fill all payload bytes.

The payload fill starts at channel 1, row 1, column 5.

Note: this is a bulk fill of the payload space, not a fill of each individual payload channel.

Note: since this is a single repeating frame there is a discontinuity of the PRBS at the boundary between the last payload byte (channel 192, row 9, column 90) and the first payload byte in the next transmitted frame.

Note: the start of the PRBS payload fill is at channel 1, row 1, column 5, this is not the start of the first payload channel. (The payload starts at row 4, column 5, corresponding to a zero value pointer).

Sonet Path Overhead and SDH HP Overhead Details

P-FEBE or HP-REI

For channel one only: the G1 path status byte can be set to no alarm (0000 0000) or set to one alarm (0001 0000).

All other channels are set to no alarm.

P-BIP-8 B3 or HP-BIP-8 B3

For each payload channel: the P-BIP-8 B3 or HP-BIP-8 B3 is set to 0111 0111.

The even parity is calculated over the last B3, path overhead and payload and the current B3. (The current B3 because this is a single repeating frame).

A selected payload byte is adjusted, as necessary, depending on the above parity result.

The selected payload byte is the byte positioned to the right of the B3 byte, located at channel 1...n, row 5, column 5.

Single B3 Error

A single B3 error per frame may be specified by the user.

To generate a B3 error: (in channel one only), one bit in a selected payload byte is complimented, (i.e. x or with 0000 0100).

The selected payload byte is the byte positioned to the right of the B3 byte, located at channel 1, row 5, column 5.

(Note: the B3 byte is unchanged).

P-AIS or HP-AIS

Always off, i.e. the G1 path status byte is 0000 0000.

The G1 path status byte, path ais off is xxxx 0000, and G1 path status byte, path ais on is xxxx 0111.

P-FERF or HP-FERF

Always off, i.e. the G1 path status byte is 0000 0000.

The G1 path status byte, path ferf off is xxxx 0000,
and G1 path status byte, path ferf on xxxx 0110.

All Other Path Overhead

All other path overhead bytes will contain 0000 0000 prior to scrambling.

Sonet Line Overhead and SDH MS Overhead Details

Pointer Bytes

All H1 bytes will be set to “not new data” and contain offset zero (0110 000).

All H2 bytes will contain offset zero (0000 000).

All H3 bytes are undefined when there are no pointer negative justifications;

(pointer increment and decrement are not available),

H3 will be used to allow a fixed B2 value, see B2 below.

L-AIS or MS-AIS

For channel one only :

The K2 byte can be set to no alarm (0000 0000) or set to alarm (0000 0111).

For the alarmed condition no other action is taken concerning any payload or other overhead bytes, these are all unchanged from the un-alarmed state.

All other “K2” bytes are unused and are set to 0000 0000.

L-FERF or MS-FERF

For channel one only :

The K2 byte can be set to no alarm (0000 0000) or set to alarm (0000 0110).

All other “K2” bytes are unused and are set to 0000 0000.

Note: L-AIS or MS-AIS and L-FERF or MS-FERF are mutually exclusive.

L-BIP-8 B2 or MS-BIP-8 B2

For each payload channel:

The L-BIP-8 B2 or MS-BIP-8 B2 is set to 0011 0011.

The even parity is calculated over the last B2, path overhead and

payload and the current B2. (The current B2 because - this is a single repeating frame).

A selected byte is adjusted as necessary depending on the above parity result.

The selected byte is the Pointer H3 byte located at: channel 1, row 4, column 3.

(The Pointer H3 byte is un-used by the signal because there are no pointer movements).

SINGLE B2 ERROR

A single B2 error per frame may be specified by the user.

To generate a B2 error: (in channel one only), one bit in a selected byte is complimented, (i.e. xor with 0000 0010).

The selected byte is the Pointer H3 byte located at: channel 1, row 4, column 3.

(Note: the B2 byte is unchanged).

L-FEBE or MS-FEBE

Always off, the 3rd Z2 byte 0000 0000.

The 3rd Z2 byte, febe off 0000 xxxx,
and 3rd Z2 byte, febe on 0001 xxxx.

ALL OTHER LINE OVERHEAD

All other line overhead bytes will contain 0000 0000 prior to scrambling.

SONET SECTION OVERHEAD AND SDH RS OVERHEAD DETAILS

S-BIP-8 B1 or RS-BIP-8 B1

For each payload channel:

The S-BIP-8 B1 or RS-BIP-8 B1 is set to 0001 0001.

The even parity is calculated over the scrambled (last B1, path overhead and payload) and the current un-scrambled B1.

(The current B1 because - this is a single repeating frame).

A selected byte is adjusted as necessary depending on the above parity result.

The selected byte is the “B1” byte in channel 2 (Sonet) or channel 2-a (SDH) located at channel 2, row 2, column 1.

(The “B1” byte in channel 2 (Sonet) or channel 2-a (SDH) is un-used by the signal).

SINGLE B1 ERROR

A single B1 error per frame may be specified by the user.

To generate a B1 error (for channel one only) one bit of a selected byte is complimented, (i.e. xor with 0000 0001).

The selected byte is the “B1” byte in channel 2 (Sonet) or channel 2-a (SDH) located at channel 2, row 2, column 1, (Note: the B1 byte is unchanged).

FRAMING

A complete framing pattern (48 or 192 xF6 + 48 or 192 x28) will be generated.

OUT OF FRAME

Out Of Frame will be generated by inverting the first A1 byte, (F6 becomes 09) and the inverting the first A2 byte, (28 becomes D7).

C1 CHANNEL IDENTIFICATION BYTES

For Sonet the STS-192 ID C1 bytes will be numbered 1 to 192.

(The physical sequence will be:1, 4, 7, ... 190, 2, 5, 8, ... 191, 3, 6, 9, ... 192).

(The logical sequence will be: 1, 2, 3, 4, 5, ... 190, 191, 192).

For SDH the STM-64 ID bytes will be number 1 to 64.

For SDH the un-defined “C1” bytes will be set to AA (1010 1010).

(The physical sequence will be: 1, 2, 3, 4, ... 63, 64, AA, AA, AA, AA).

(The logical sequence will be: 1-a, 2-a, 3-a, 4-a, ... 63-a, 64-a, 1-b, 2-b, ... 63-c, 64-c).

Similar numbering applies to STS-48 and STM-16.

ALL OTHER SECTION OVERHEAD

All other section overhead bytes will contain 0000 0000 prior to scrambling.

CID PATTERN DETAILS

Following the CCITT G958 Recommendations:

The CID pattern is:

[D]=[A][B][D][C][B] ... repeating

[D] = A1...n A2...n C1...n (n = either 48 or 192) (Section overhead unscrambled bytes)

[A] = all 1's ... 9 bytes long

[B] = prbs 7 ... length X

[D] = A1...n A2...n C1...n (n = either 48 or 192)

[A] = all 0's ... 9 bytes long

[B] = prbs 7 ... length X

Recommended length X = 10, 000 bits (ideal) to 2, 000 bits (minimum), but is not precisely defined in G958. The duration of section B must be longer than the longest time constant in the clock recovery system.

This implementation uses one Sonet/SDH "frame" to carry the CID pattern as follows:

A1 A2 and C1 bytes as a normal frame [D] block of bytes set to all 1's [A] normal scrambler sequence starting with 1111 111 [B] half way through the frame, at row 5 column 40, an A1 A2 C1 sequence is inserted [D] block of bytes set to all 0's [A] normal scrambler sequence starting with 1111 111 [B]

The length X is either

$(78 + 90 + 90 + 90 + 40) * 8 * 48 = 148,992$ bits (STS-48) or $(87 + 90 + 90 + 90 + 40) * 8 * 192 = 595,968$ bits (STS-192) both corresponding to a time constant of about 4 mSec.

The recommendation states that the scrambler should free run so that all possible sequences follow the block of 1's or 0's. This cannot be achieved with a memory based pattern.

As an alternative, the block length is user definable over the range 0 to 100, and default to the recommended value 9. Block lengths greater than 9 allow additional stress to be applied.

For STS-48 and STS-192 the ability to vary the prbs phase would have little effect, because the A1 A2 and C1 pattern plus the 9 byte block is much longer than a few bytes of a 2^7 prbs.

