HP E2975A PCI Protocol Permutator and Randomizer

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Technical Specifications

HP E2920 Computer Verification Tools, PCI Series

Part of the HP E2920 PCI Series of Computer Verification Tools, the HP E2975A PCI Protocol Permutator and Randomizer software increases the test coverage of the PCI protocol verification of PCI chips, chip sets and systems. Offering a complete set of C-functions for the HP E2925A PCI Exerciser and Analyzer, the HP E2975A PCI Protocol Permutator and Randomizer intensifies the testing of master transactions and target behavior by automatically permutating protocol variations within user-programmed constraints.

Systematic PCI protocol verification with increased test coverage
By adding automatically-permutated PCI protocol variations, the HP E2975A can test not only single protocol behaviors, but also a full range of PCI protocol variations when checking for PCI protocol compliance.

Devised for design and test engineers, the HP E2975A offers an effective solution which validates the correct PCI protocol behavior of PCI chips, chip sets and complete systems in a fast, efficient and systematic way.

Basic concepts of PCI protocol permutations
The fundamental aim of the HP E2975A is to prepare the HP E2925A PCI Exerciser and Analyzer to transfer a contiguous block of data with as many PCI protocol variations as possible.

Therefore, the HP E2975A software calculates which variations are covered, and after how many data transfers, by permutating the possible protocol variations. It determines whether the coverage, within programmed constraints, can be achieved under given test circumstances, and calculates the test time required to perform the data transfers.

To expose the device-under-test to the protocol variations, the HP E2975A PCI Protocol Permutator and Randomizer uses the HP E2925A PCI Exerciser and Analyzer to perform a series of master and target protocol variations. The information on which transfer has to be performed with which protocol variation is stored in the hardware. The software programs the hardware so that it is guaranteed that all desired protocol permutations will be executed.

Key Features

- Automatic PCI protocol permutation within user-programmed constraints, e.g. for bus commands, address alignment, burst length, waits, etc.
- Acts as master or target.
- Predictable test coverage.
- Predictable test time.
- Comprehensive report of performed protocol variation.
- Deterministic and repeatable test conditions.

Generating permutations
The user-defined protocol constraints can be easily set by specifying lists of protocol variations which must occur, for example, which different burst lengths, wait cycles, memory read/write commands, etc.

Then, the HP E2975A software automatically moves simultaneously through the lists. With each step, that is, with each permutation, the next value in this list is combined with the next values in the other lists. The software proceeds in this way until each value of each list is combined with all values of the

other list, and thus all combinations are covered. In this way, the repetition or omission of combinations is avoided.

Test coverage
Up to two million protocol variations within the desired test constraints can be performed without reprogramming. Therefore, the test coverage can be significantly increased.

A printable report tells you to which protocol variation the device has been exposed. It explicitly reports which protocol attributes are permutated against which other protocol attributes, and after how many data transfers.

Optimized test time
The values to be varied can be specified for each master and target attribute separately. Thus, testing time can be optimized by focusing on interesting cases.

By carrying out these protocol permutations at real-time within the PCI exerciser hardware, these tests run much more quickly than any other CPU-based test program.

Effective test generation
The exhaustive C-library makes it simple to focus on test structuring, partitioning and the specification of protocol constraints. This means that an appropriate and valuable test for PCI protocol verification with meaningful results can quickly be obtained.

Once started, the test can be easily extended to incorporate newly-gained experiences or to address testing needs for newly-invented PCI features.

Deterministic test conditions
In contrast to PCI traffic generated by other PCI cards, the generated variations are completely deterministic and reproducible.

PCI protocol check
The comprehensive analyzing capabilities of the HP E2925A can be used concurrently with the PCI protocol permutation. Thus, by using either the C-API commands or the HP E2970A PCI Analyzer GUI, root cause analysis and error localization, including real-time PCI protocol check, can be carried out.

Even in the event of bus hang-up, the last block of transferred data can be identified for a simple repetition of error conditions.

Supported Protocol Variations

The HP E2925A allows the variation constraints for the PCI transfer, PCI master and PCI target behavior to be specified. All specified constraints can be permutated against each other, and up to 100 constraints can be maintained per list.

PCI transfer variations
- Start address alignment;
  a list of arbitrary address alignments to start PCI transfers at given offsets (e.g. 1 dword) relatively to the given address granularity (e.g. 32 byte boundary).
- Byte enables;
  a list of selected values for the C/BE lines during the address phase.
- Block size;
  a block describes a contiguous range in memory available to be transferred. A list of up to 100 different block sizes (from 4 to 128 kbyte) to be transferred can be selected.
- Bus commands;
  a list of selected PCI bus commands. All selected commands are permutated with other selected constraints, as appropriate, for the specified transfer direction and PCI specifications.

Master attribute variations
- Burst length;
  a list of selected burst lengths ranging from 1 to 32 kDwords.
- Address stepping.
- Request line release;
  a list of different values of when the REQ# line has to be released.

Target attribute variations

- Termination;
  allows a list of different termination modes for use to be specified, i.e. no termination, termination with retry, with disconnect, and with target abort.

Master/target attribute variations

- Wait cycles;
  a list of selected wait cycles ranging from 0 to 31.
- Data stepping.
- Parity/system errors;
  lists specifying how PERR/PAR/SERR should be considered for permutations.

Measurement and Resource Requirements

The HP E2975A Protocol Permutator and Randomizer requires the HP E2925A PCI Exerciser and Analyzer. The HP E2975A can be operated concurrently with any other HP E2920 Series software.

The C-functions provided are usually incorporated into a test program operated on the device-under-test. The HP E2925A is also plugged into the device-under-test and is normally controlled directly through the PCI. Alternatively, the test program can also be written for an external host, controlling the HP E2925A either through RS232 or through the HP E2925A option 002 fast host interface.

System Requirements

The HP E2975A is delivered as a C source code and Dynamic Link Library (DLL) for:

- Windows NT rev. 3.51,
- Windows NT rev. 4.0,
- Windows 95.

If you wish to operate any additional HP E2920 PCI Series software products, you must consider the system requirements, as specified in the appropriate technical specifications documents.

Ordering Information

The HP E2975A includes a single user license for the protocol permutator and randomizer software library, to be used with one HP E2925A at a time. The software media is stored on CD-ROM.

The HP E2975A requires one HP E2925A PCI Exerciser and Analyzer.

Related HP Literature

- HP E2920 Computer Verification Tools, PCI Series, brochure, p/n 5965-4723E.
- HP E2925A 32 bit, 33 MHz PCI Exerciser and Analyzer, technical specifications, p/n 5965-4724E.
- HP E2970A PCI Analyzer Graphical User Interface for Windows 95/NT, p/n 5965-4726E.
- HP E2971A PCI Exerciser Graphical User Interface for Windows 95/NT, technical specifications, p/n 5965-4725E.
- HP E2972A PCI Performance Analyzer, technical specifications, p/n 5965-8008E.
- HP E2974A Sub-System Stress Tests, technical specifications, p/n 5965-8009E.

For more information, a detailed introduction to this concept can be found on the www at: http://www-europe.hp.com/dvt

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