# E4219A
# ATM Network Impairment Emulator

## The HP Broadband Series Test System Technical Specification

## 1. Product Description

Part of the modular HP Broadband Series Test System (BSTS), the E4219A ATM Network Impairment Emulator module provides the capability to insert cell loss, cell error, cell misinsertion, cell delay and cell delay variation impairments into an ATM cell stream at rates up to 155 Mb/s.

Ideal for network equipment manufacturers, service providers, R&D labs and CPE vendors, the ATM Network Impairment Emulator emulates real-world effects of impairments in an ATM network.

### Key Features

*Emulates real-world impairments*

- Inserts constant cell delay, cell delay variation, cell loss, cell error and cell misinsertion into an ATM cell stream

*Impairment distributions*

- Several statistical distributions, including user-defined, are available for cell error, cell loss, cell delay variation and cell misinsertion

*Wide delay range*

- Up to 220 ms (+/-3 %) cell delay at 155 Mb/s
- Up to 2.57 ms (+/-3 %) cell delay variation at 155 Mb/s

*User-program environment*

- Write your own C-language user programs for automated testing

*Filter on any cell header*

- Select impaired cell streams by field filtering on any ATM cell header field

*Works with CPP*

- Works with an E4209B Cell Protocol Processor to insert additional traffic such as signalling

*Cascadable*

- Cascade up to four modules to increase total delay or provide impairments for additional VPI/VCIs

*Full regulatory approval*

- Meets EMI emission standards

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### 1.2) Applicable Standards

*Impairments*

ITU-T Recommendation I.356, B-ISDN ATM Cell Layer Cell Transfer Performance, 1993

*ATM*

ITU-T Recommendation I.361 B-ISDN ATM Layer Specification, 1993; ITU-T Recommendation I.150 B-ISDN ATM Functional Characteristics, 1993

### 1.3) Use With Other BSTS Line Interfaces, Hardware Modules & Test Software

When installed in a BSTS chassis, the E4219A ATM Network Impairment Emulator can emulate impairments with all BSTS ATM-based line interfaces at rates up to 155 Mb/s.

| *Speed* | *Line Interface* |
|---|---|
| 1.5 Mb/s | E1616A 1.5/45 Mb/s (T1/T3) Line Interface |
| 2 Mb/s | E4201A 2.048 Mb/s (E1) Line Interface |
| 6.3 Mb/s | E1613A 6.3 Mb/s Electrical Line Interface |
| | E1614A 6.3 Mb/s Optical Line Interface |
| 25.6 Mb/s | E1619A 25.6 Mb/s (4B/5B) Line Interface |
| 34 Mb/s | E1610A 34 Mb/s (E3) Line Interface |
| 45 Mb/s | E1616A 1.5/45 Mb/s (T1/T3) Line Interface |
| | E1695A 45 Mb/s (T3) Line Interface |
| 52 Mb/s | E1617A 52 Mb/s (OC-1) Line Interface |
| 155 Mb/s | E1612A 155 Mb/s Electrical Line Interface |
| | E1697A 155 Mb/s (SONET/SDH) Optical Line Interface |
| | E4203A 155 Mb/s Protocol Line Interface |
| | E4205A 155 Mb/s (UTP-5) Line Interface |

Additionally, this module can be used with an optional E4209B Cell Protocol Processor and test software to provide test capabilities at the ATM, AAL and Services layers.

Several test software packages are available for traffic analysis, simulation, signalling, performance and conformance testing. See the following technical specifications for more information.

- *E4209B Cell Protocol Processor Technical Specifications* publication 5963-7403E
- *E4211A SMDS Test Software Technical Specifications*, publication 5963-7402E
- *E4212A AAL Test Software Technical Specifications*, publication 5963-7401E
- *E4214A LAN Protocols Test Software Technical Specifications*, publication 5963-7398E
- *E4215A UNI Signalling Test Software Technical Specifications*, publication 5963-7399E
- *E4226A MPEG-2 Protocol Viewer Test Software Technical Specifications* publication 5964-2107E

### 1.4) User Programming

You can automate testing or set up complex scenarios by executing your own programs on the BSTS's embedded UNIX® controller.

Access the E4219A ATM Network Impairment Emulator by simply linking your code with a library of test routines. A UNIX workstation environment is provided on the BSTS, including networking tools and utilities.

### 1.5) Documentation Included

- User's Guide
- Programmer's Guide

## 2. Impairment Emulation

### 2.1 Impairment Independent Parameters

| *Channel Parameters* | |
|---|---|
| Total bandwidth | Up to 149.76 Mb/s |
| Modes | UNI or NNI |
| Empty Cell Definition | Idle or unassigned |

| *ATM Header Matching or Misinsertion Values* | |
|---|---|
| VCI | Any value 0 to 65536 |
| VPI | Any value 0 to 255 (UNI) or 0 to 4095 (NNI) |
| GFC | Any value 0 to 15 (UNI) |
| Payload type | Any value 0 to 7 |
| Cell loss priority | Set priority to 1 or 0 |
| Cell type | ATM |

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### 2.2 Variable Cell Delay

Variable cell delays are caused by congestion, cell blocking and multiplexing. Delays can be specified in milliseconds or multiples of four cells; delay scales as a function of line rate. There is an inertial delay associated with the data path of the E4219A which should be calibrated as described in the product documentation.

| *Distributions* | *Parameter/s* |
|---|---|
| Binomial | User-specified mean & standard deviation |
| Geometric | User-specified mean |
| User Defined | User-specified X,Y pairs representing desired probability density function |

| *Variable Cell Delay Range* | |
|---|---|
| CDV | 0 to 926 cells |

To quickly estimate maximum cell delay variation in seconds, divide 392,624 bits (926 cells x 53 octets per cell x 8 bits per octet) by line rate. Note that this calculation ignores any additional framing bits.

### 2.3 Constant Cell Delay

Constant cell delay results from fixed network delays, such as lengthy transmission distances and switching delays.

| *Constant Cell Delay Range* | |
|---|---|
| CD | 0 to 79,136 cells |

To quickly estimate maximum constant cell delay in seconds, divide 33,553,664 bits (79,136 cells x 53 octets per cell x 8 bits per octet) by line rate. Note that this calculation ignores any additional framing bits.

### 2.4 Cell Error

Cell errors are caused by bit errors caused by line noise. Errored bytes are selected from the payload according to the specified distribution. The E4219A module can introduce up to four consecutive bit errors. The header cannot be errored. Errors can be specified in terms of cells or bytes.

| *Distributions* | *Parameter/s* |
|---|---|
| Normal | User-specified mean error interval from 5 to 2E10 cells or 1000 to 1E12 bytes with user-specified standard deviation |
| Exponential | User-specified mean error interval from 5 to 2E10 cells or 1000 to 1E12 bytes |
| Deterministic | User-specified cell error rate from 5E-11 to 2E-1; byte error rate from 1E-12 to 1E-3. |
| Uniform | User-specified lower error interval limit of 5 cells or 1000 bytes; user-specified upper error interval limit of 2E10 cells or 1E12 bytes |
| User Defined | User-specified X,Y pairs representing error intervals from 5 to $2^{32}$-1 cells or 1000 to $2^{32}$-1 bytes with associated probability from 0.0 to 1.0 |

### 2.5 Cell Loss

Cell loss results from such network problems as buffer overflow, switch malfunction, traffic policing, and uncorrectable header errors. The E4219A module can introduce bursts of up to eight consecutive cell losses. Lost cells can be replaced either by idle cells or by cells with user defined headers.

| *Distributions* | *Parameter/s* |
|---|---|
| Normal | User-specified mean error interval from 1000 to 1E12 cells with user-specified standard deviation |
| Exponential | User-specified mean error interval from 1000 to 1E12 cells |
| Deterministic | User-specified cell error rate from 1E-12 to 1E-3 |
| Uniform | User-specified lower limit of error interval 1000 cells; user-specified upper error interval limit of 1E12 cells |
| User Defined | User-specified X,Y pairs representing error intervals from 1000 to $2^{32}$-1 cells with associated probability from 0.0 to 1.0 |

### 2.6 Cell Misinsertion

Cell misinsertion is caused by transmission errors and situations where an undetected header error matches an existing VPI/VCI. The header of the misinserted cell can be fully specified by the user. The first two and last two payload octets of the misinserted cell can be independently specified. A fill pattern for payload bytes 3-46 can also be specified.

| *Distributions* | *Parameter/s* |
|---|---|
| Normal | User-specified mean error interval from 1000 to 1E12 cells with user-specified standard deviation |
| Exponential | User-specified mean error interval from 1000 to 1E12 cells |
| Deterministic | User-specified cell error rate from 1E-12 to 1E-3 |
| Uniform | User-specified lower error interval limit of 1000 cells; user-specified upper error interval limit of 1E12 cells |
| User Defined | User-specified X,Y pairs representing error intervals from 1000 to $2^{32-1}$ cells with associated probability from 0.0 to 1.0 |

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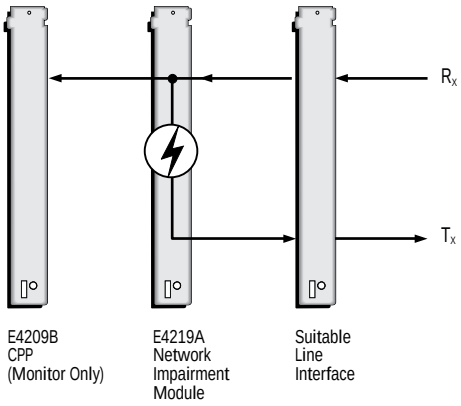
## 3. External Triggers

External TTL trigger pulses may be output through the connector on the E4219A front panel. This allows the module to work in conjunction with other hardware. Triggers can be output under the following circumstances.

| | |
|---|---|
| Variable Cell Delay | The delay value changes |
| Cell Misinsertion | A cell has been misinserted by the module |
| Cell Error | A byte or cell has been errored by the module |
| Cell Loss | A cell has been lost by the module |
| Constant Cell Delay | A cell has been delayed by the module |
| Incoming | The module detects an incoming non-empty cell |
| Outgoing Non-Empty Cell | The module detects an outgoing non-empty cell |

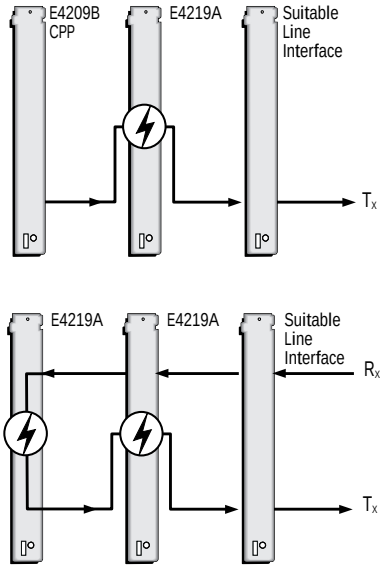
## 4. Configuration Modes

| | |
|---|---|
| Terminated | Default interface mode; cells received through the cell bus from the module on the right are impaired by the E4219A, then looped back through the cell bus to the same module on the right. |
| Cascaded | Default interface mode when the test application includes another module located to the left of the E4219A (i.e. a CPP). Cells received through the cell bus from the module on the right pass through the E4219A without sampling or modification. Cells received through the cell bus from the module on the left are impaired by the E4219A, then sent through the cell bus to the next module on the right. |
| Disabled | This mode is used when the E4219A is to be temporarily removed from the application without having to stop the application and start a new one. Cells received through the cell bus from modules to the right or left pass through the E4219A modification. |




### Terminated Mode

- impairs traffic received via line interface with CPP monitoring
- use two E4219A/LIF pairs for full-duplex configuration




### Cascaded Mode

- impairs CPP-generated traffic
- use two or more E4219A modules to create very lengthy delays or apply different impairments to other virtual channels or paths

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# 5. Input and Output

## 5.1) I/O Connectors

| | |
|---|---|
| Trigger Out | TTL output; BNC socket |
| Test out | TTL output; BNC socket |

## 5.2) LED Status Indicators

| *Status LED* | *Color* | *Indicator Description* |
|---|---|---|
| Failed | Red | Lights during startup; if the module passes the self-test, the light turns off; otherwise it stays lit |
| Access | Green | Module is currently being accessed by the VXI control bus |
| CDV | Green | Variable cell delay impairments are enabled |
| | Red | A change in delay has been introduced by the module |
| Cell Error | Green | Cell error impairments are enabled |
| | Red | A byte or cell has been errored by the module |
| Cell Drop | Green | Cell loss impairments are enabled |
| | Red | A cell has been lost by the module |
| Cell Misinsert | Green | Cell misinsertion impairments are enabled |
| | Red | A cell has been misinserted by the module |
| Cell Delay | Green | Constant cell delay impairments are enabled |
| | Red | A cell has been delayed by the module |

# 6. Physical Specifications

## 6.1) VXIbus Characteristics

| | |
|---|---|
| Device type | Register based |
| Backplane connectors | P1 and P2 (as per VXIbus Specification Rev 1.3) |
| Local bus LBUSA | Active connection to and LBUSC |
| Module keying | ECL |
| Power dissipation | 25 W max |

## 6.2) Size and Weight

| | |
|---|---|
| Size | 1 C-sized slot |
| Weight | 1.5 kg (2.9 lb) nominal |

## 6.3) Operating Environment

| | |
|---|---|
| Operating temperature | 0 to 55 degrees C |
| Storage temperature | -40 to 75 degrees C |
| Humidity | 50 to 95% RH over 25 to 40 degrees C |
| Safety | Conforms with EN 61010:1993 / IEC 1010-1:1990 + A1 |
| EMC | Conforms with EN 55011:1991/CISPR 11:1990 (Group 1, Class A), EN 50082-1:1992 (IEC 801-2:1991; IEC 801-3:1984; IEC 801-4:1988) |

# 7. Ordering Information

| *Part number* | *Description* |
|---|---|
| E4219A | ATM Network Impairment Emulator; includes module and documentation |
| E4219A-002 | Additional User's Guide |
| E4219A-003 | Additional Programmer's Guide |

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## 8. For More Information

For an introduction to the modular Broadband Series Test System, please see brochure 5962-9751E. An ordering guide, publication 5964-0393E, helps you determine the appropriate system configuration for your testing needs. Technical specifications detailing other hardware modules and test software packages for the BSTS are also available. To find the location of your local HP sales office, please contact the nearest regional sales headquarters listed to the right.

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