



# The RFC 2544 Application – Performance Benchmarking for the HaulPass V60s Link

The RFC 2544 standard, established by the Internet Engineering Task Force (IETF), is a methodology that outlines the tests required to measure and prove performance criteria in Ethernet networks. The standard provides a benchmarking methodology to evaluate the performance of network devices using throughput, frame loss, and latency tests. The methodology defines the frame size, test duration, and number of test iterations.

By running the Vubiq Networks RFC 2544 application, installers and end users can avoid the tedious, time-consuming manual method of RFC 2544 testing. In addition, the application allows users to conduct field performance tests without the need to procure expensive field testing equipment.

This Tech Note provides step-by-step instructions for provisioning and completing a RFC 2544 test for your HaulPass V60s wireless link. Before configuring your V60s Terminals to run the RFC 2544 application, please note the following warnings:

- Running this code will make your link unavailable for live traffic.
- Performing the test incorrectly may put large amounts of traffic onto your network.
- A failed test may require you to reboot a HaulPass V60s link in order to recover.
- It is assumed that the V60s Link is working with reliable pinging of both the local and remote V60s units

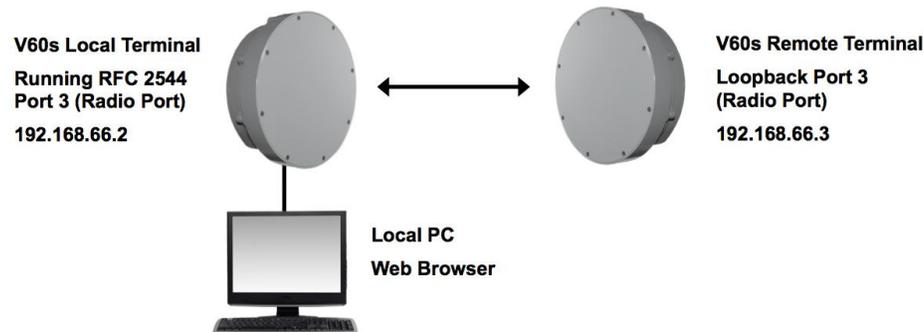
## Running the RFC 2544 Application

This Tech Note is organized as follows:

- Section 1: Configuration
- Section 2: Set up the Remote V60s Terminal
- Section 3: Set up the Local V60s Terminal
- Section 4: Sample Report
- Section 5: Performance Notes
- Section 6: RFC 2544 GUI Parameters

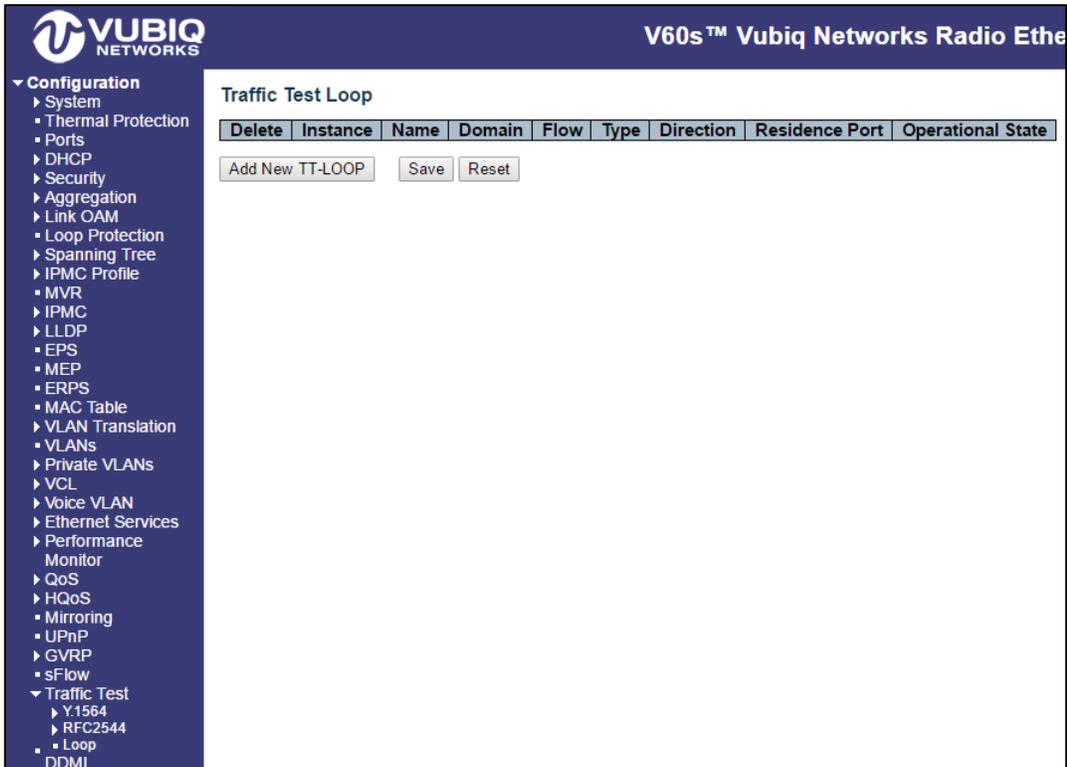
## 1 Configuration

For clarification of the terms used for network configuration, please refer to the diagram below:

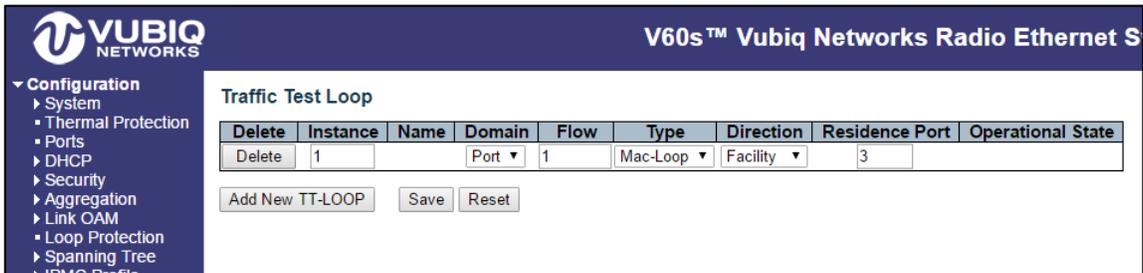


## 2 Set up the Remote V60s Terminal

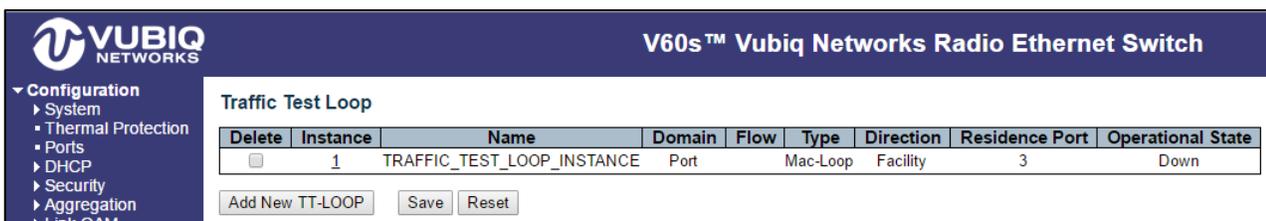
1. Log in to the remote V60s Terminal via a web browser.
2. The next step is to navigate to Traffic Test Loop. This can be done by clicking on **Configuration > Traffic Test > Loop**.



3. Click on **Add New TT-LOOP**, verify that the Residence Port is set to 3 and click **Save**.



4. After saving, the screen will look like this:



- Click on the **Instance 1**. Your screen should change. Completing this step will effectively disable flow of normal traffic. Change **Admin State** to enable and click **Save**. Once you click **Save**, you will not be able to talk to the remote unit until it is power cycled or someone attaches to the terminal via Ethernet on ports 1 or 2 (the normal Ethernet ports) to disable this loopback for one hour. At this stage, your browser will be unresponsive while waiting for the remote V60s Terminal, this is normal behavior.

The configuration of the remote V60s Terminal is now complete.

Note: You have one hour to complete the RFC 2455 test on the local terminal. At the one hour point the remote terminal will drop out of loopback mode and the RFC 2455 test will fail if it has not completed.

The screenshot shows the VUBIQ NETWORKS V60s™ Vubiq Network configuration interface. The left sidebar contains a 'Configuration' menu with various options like System, Thermal Protection, Ports, DHCP, Security, Aggregation, Link OAM, Loop Protection, Spanning Tree, IPMC Profile, MVR, IPMC, and LLDP. The main content area is titled 'Traffic Test Loop Configuration' and includes an 'Instance Data' table and an 'Instance Configuration' table.

Instance	Domain	Flow	Type	Direction	Residence Port	Oper State
1	Port	Mac-Loop	Facility	3	Down	

Name	Admin State
TRAFFIC_TEST_LOOP_INSTANCE	Enable

Buttons for 'Save' and 'Reset' are located at the bottom of the configuration area.

### 3 Set up the Local V60s Terminal

- Log in to the local V60s Terminal via a web browser.
- The next step is to navigate to the RFC 2544 Profiles. This can be done by clicking on **Configuration > Traffic Test > RFC2544 > Profiles**.

The screenshot shows the VUBIQ NETWORKS V60s™ Vubiq Network configuration interface. The left sidebar contains a 'Configuration' menu with various options like System, Thermal Protection, Ports, DHCP, Security, Aggregation, Link OAM, Loop Protection, Spanning Tree, IPMC Profile, MVR, IPMC, LLDP, EPS, MEP, ERPS, MAC Table, VLAN Translation, VLANs, Private VLANs, VCL, Voice VLAN, Ethernet Services, Performance Monitor, QoS, HQoS, Mirroring, UPnP, GVRP, sFlow, and Traffic Test. The main content area is titled 'RFC2544 Profile Overview' and includes a table with 'Delete', 'Name', and 'Description' columns.

Delete	Name	Description
Delete	V60	

An 'Add New Profile' button is located below the table.

3. Click on **Add New Profile**.

The screenshot shows the 'RFC2544 Profile Configuration' page. The left sidebar contains a navigation menu with 'Configuration' expanded to 'Traffic Test' > 'RFC2544' > 'Profiles'. The main content area is titled 'RFC2544 Profile Configuration' and contains several sections:

- Common Parameters:** Profile Name: RFC2522\_Test, Description: (empty), MEG Level: 7, Egress Port: Port 3, Sequence Number Check: , Dwell Time: 2 secs, Type: Port Down-MEP, VLAN ID: 1, PCP: 0, DEI: 0, DMAC: 00-00-00-00-00-01.
- Frame Sizes:** Checkboxes for 64, 128, 256, 512, 1024, 1280, 1518, 2000, 9600.
- Tests to Run:** Checkboxes for Throughput, Latency, Frame Loss, Back-to-Back.
- Throughput Test Parameters:** Trial Duration: 60 secs, Minimum Rate: 800 %, Maximum Rate: 1000 %, Accuracy: 2 %, Allowed Frame Loss: 5 %.
- Latency Test Parameters:** Trial Duration: 120 secs, Delay Meas. Interval: 10 secs, Allowed Frame Loss: 5 %.

Buttons for 'Save', 'Reset', and 'Cancel' are at the bottom.

Add a name and change **Egress Port** to Port 3 (radio port). Change Allowed Frame Loss (Under Throughput Test Parameters) to 5. Change Allowed Frame Loss (Under Latency Test Parameters) to 5. Adjust other parameters as needed. An explanation of these parameters is located in Section 6 later in the Tech Note.

Click **Save**.

4. After saving, the screen should look like this:

The screenshot shows the 'RFC2544 Profile Overview' page. The left sidebar is the same as in the previous screenshot. The main content area is titled 'RFC2544 Profile Overview' and contains a table with the following data:

Delete	Name	Description
Delete	V60	
Delete	RFC2544_Test	

There is an 'Add New Profile' button below the table.

5. Then click on **Configuration > Traffic Test > RFC2544 > Reports**.

The screenshot shows the 'RFC2544 Report Overview' page. The left sidebar is the same as in the previous screenshot. The main content area is titled 'RFC2544 Report Overview' and contains a table with the following data:

Action	Save	Name	Description	Created	Status
<No test reports>					

There is a 'Start New Test' button below the table.

Click on **Start New Test**.

6. Now name your report.

The screenshot shows the VUBIQ NETWORKS V60s™ Vubiq Net interface. On the left is a navigation menu with 'Configuration' expanded to show options like System, Thermal Protection, Ports, DHCP, Security, Aggregation, Link OAM, and Loop Protection. The main area is titled 'RFC2544 Test Start' and contains a form with three fields: 'Report Name' (RFC2544\_Test), 'Description' (This is my test.), and 'Profile' (RFC2522\_Test). Below the form are 'Run' and 'Cancel' buttons.

Click Run.

7. At this point, the test is being conducted.

The screenshot shows the VUBIQ NETWORKS V60s™ Vubiq Network interface. The main area is titled 'RFC2544 Report Overview' and contains a table with the following data:

Action	Save	Name	Description	Created	Status
Stop	Save	RFC2544_Test	this is my test.	1970-01-01T02:40:29+00:00	Executing

Below the table is a 'Start New Test' button. The 'Name' column header and the 'RFC2544\_Test' entry are circled in red in the original image.

Check the **Auto Refresh** check box and wait for your results.

The screenshot shows a control panel with three icons (Home, Refresh, Help) at the top. Below them is a section with 'Auto-refresh' checked and a 'Refresh' button.

You can also click on the name of your report to see the results as they are generated. Click **Save** to download your results.

## 4 Sample Report

The results file will look something like this:

```
*****
* RFC2544 Conformance Test Suite
*****
Software configuration:
  Version          : V60sV60sdev-build by vubiq@vubiq 2016-07-12T16:13:35-07:00
Config:/srv/samba/share/VitesseWork/build/./build/config
  Build date       : 2016-07-12T16:13:35-07:00

Report configuration:
  Report name      : RFC2455_Test
  Description      : This is my test.

Overall execution status:
  Started at       : 1970-01-01T02:44:14+00:00
  Ended at         : 1970-01-01T03:08:46+00:00
  Status           : Succeeded

Common configuration:
  Profile name     : V60
  Description      :
  MEG Level       : 7
  Egress interface : GigabitEthernet 1/3
  Sequence number check: Disabled
  Dwell time      : 2 seconds
  Type            : Port Down-MEP
  Destination MAC  : 00-00-00-00-00-01
  Source MAC       : 68-28-f6-00-0c-77
  Frame sizes      : 64 128 256 512 1024 1280 1518 2000
  Throughput test  : Enabled
  Latency test     : Enabled
  Frame loss test  : Disabled
  Back-to-back test : Disabled

***** Throughput Test *****
Throughput configuration:
  Trial duration    : 60 seconds
  Minimum rate     : 800 permille
  Maximum rate     : 1000 permille
  Accuracy         : 2 permille
  Allowed frame loss : 50 permille

Throughput status:
  Started at       : 1970-01-01T02:44:14+00:00
  Ended at         : 1970-01-01T02:52:30+00:00
  Status           : Succeeded

Frame  Tx    Rx    Tx    Rx    Tx    Rx    Frame Status
Size   Rate  Rate  Rate  Rate  Frames  Frames  Loss
[bytes] [Mbps] [Mbps] [fps]  [fps]
-----
   64  999.9  999.8 1487995 1487879  89279740  89272747  0.0 PASS
  128 1000.0 1000.0  844608  844603  50676534  50676189  0.0 PASS
  256  999.9  998.1  452891  452081  27173469  27124907  0.1 PASS
  512  999.9  999.9  234957  234944  14097466  14096644  0.0 PASS
 1024  999.9  999.9  119730  119722   7183807  7183328  0.0 PASS
 1280  999.9  982.0   96151   94432   5769098  5665944  1.7 PASS
 1518 1000.4  995.8   81309   80934   4878578  4856046  0.4 PASS
 2000  999.9  989.1   61880   61212   3712810  3672739  1.0 PASS
```

\*\*\*\*\* Latency Test \*\*\*\*\*

Latency configuration:

Trial duration : 120 seconds
Delay meas. interval : 10 seconds
Allowed frame loss : 50 permille

Latency status:

Started at : 1970-01-01T02:52:30+00:00
Ended at : 1970-01-01T03:08:46+00:00
Status : Succeeded

Table with 7 columns: Frame Size [bytes], Tx Rate [Mbps], Tx Frames, Rx Frames, Min/Avg/Max Delay [usecs], Min/Avg/Max Delay Var. [usecs], Status. Rows show test results for frame sizes 64, 128, 256, 512, 1024, 1280, 1518, and 2000 bytes, all with 'PASS' status.

\*\*\*\*\* Overall Result \*\*\*\*\*

Ended at : 1970-01-01T03:08:46+00:00
Status : Succeeded

\*\*\*\*\*

5 Performance Notes

A high quality wireless link has the ability to pass a RFC 2544 latency and throughput test. However, "frame loss" tests specify that any error is a failure. There will be failures on the "frame loss" tests even though the error percentage is less then 1/10th of a percent packet loss. We set the acceptable Frame Loss to 5% when we test.

## 6 RFC 2544 GUI Parameters

### 6.1 RFC 2544 Profile Edit Help

A profile defines key parameters and sub-tests to be executed as part of the RFC2544 benchmark testing. The profile configuration is divided into a common section which contains parameters shared by the four tests that can be defined for a profile.

All rates configured in a profile are measured in permille of the line rate. The reason for not using bits per second or other units is that egress ports may be configured at various speeds, so in order to have a link-speed independent way of configuring rates, permille of the line rate is chosen.

All rates configured in a profile are interpreted as requested rates on the customer-facing side of the switch. The egress port on which the tests are conducted is considered the network-facing side. If the switch adds a VLAN tag to the frames Type the rate on the network-facing side will be higher than the requested customer-facing side's rate. The exception being that the rate, of course, cannot exceed the line rate.

### 6.2 Common Parameters

#### Profile Name

Each profile must have a name that uniquely identifies it, since it is this name that is used in the process of executing a profile. The length must be from 1 to 32 characters with each ASCII character being in the range [33:126].

#### Description

This field allows for providing a textual description of the profile. Up to 128 characters can be entered.

#### MEG Level

The frame types used in the various tests are Y.1731 TST and 1DM frames, both of which contain a MEG Level (MEL) field, which can be controlled with the value entered in this select box, which ranges from 0 to 7 with 7 being the default.

#### Egress Port

The port on which the generated frames are transmitted **and** expected received.

#### Sequence Number Check

When checked, looped Y.1731 TST frames are tested for out-of-order upon reception. Out-of-order frames are frames received in a different order than they were transmitted. If an out-of-order sequence is detected, the sub-test or trial is considered failing.

#### Dwell Time

When a trial is executed, Y.1731 TST frames are transmitted for a certain period of time. When that period has elapsed, the Dwell Time determines how long to wait before reading hardware counters and status in order to assess the status of the trial. The required dwell time must be at least the worst-case round trip time, and therefore depends on the physical distance between the near and far ends. Valid range is from 1 to 10 with a default of 2 seconds.

#### Type

The RFC 2544 test suite supports to types of tagging of frames on egress:

- **Port Down-MEP**, where all frames are transmitted untagged.
- **VLAN-based Down-MEP**, where all frames are transmitted with a VLAN tag. In order for this to work, the following manual VLAN configuration of the egress port is required:
  - The VLAN Port Mode must be Trunk or Hybrid in order to get frames tagged upon transmission.

- The VLAN Port Type must be either of C-, S-, or S-Custom.
- VLAN Egress Tagging must be set to either tag all or un-tag Port VLAN. In the latter case the chosen VLAN ID for the profile must be different from the configured VLAN Port VLAN ID.
- The port must be member of the chosen VLAN ID.

Whether one or the other type is selected, frames are generated as close to the egress port as possible (hence the “Down-MEP” term) and therefore not sent through the queuing system, due to lack of integration with EVCs in this version of the software. When VLAN-based Down-MEP is selected, the VLAN tag's ID, PCP, and DEI values are selected with the subsequent fields.

## VLAN ID

When Type is set to VLAN-based Down-MEP, this field determines the VLAN ID used in the tag. Valid values are in the range 1 to 4095.

## PCP

When Type is set to VLAN-based Down-MEP, this field determines the PCP value used in the VLAN tag.

## DEI

When Type is set to VLAN-based Down-MEP, this field determines the DEI value used in the VLAN tag.

## DMAC

This field determines the destination MAC address used in generation of the Y.1731 TST and 1DM frames. The source MAC address will automatically become the egress port's native MAC address. Note that it is important that the remote end swaps DMAC and SMAC while looping the frame.

## Frame Sizes

Each sub-test is repeated for every selected frame size. At least one frame size must be checked. By default, all but the jumbo frame size are selected.

## Tests to Run

One or more of the following sub-tests may be executed through the same profile.

- **Throughput:** The throughput test searches for the maximum rate at which at most a certain percentage of the frames are lost. The throughput test starts at the maximum configured rate and uses a dichotomist algorithm (binary search) to find the optimum rate. The trials continue until the difference between a failing and succeeding rate is smaller than the configured accuracy.
- **Latency:** The latency test measures the round-trip time of frames leaving the near-end until they get back to the near-end. Y.1731 TST frames are transmitted at the maximum rate determined by the throughput test less 200 Kbps. Every so many seconds, a Y.1731 1DM frame is transmitted and the time from this frame leaves the switch until it comes back is measured. If more than two 1DM frames are transmitted during a trial, also the delay variation will be part of the generated report. Selecting the latency test causes the throughput test to be selected automatically.
- **Frame Loss:** The frame loss test measures frame loss at configurable transmission rates. It starts at the configured maximum rate and steps down by the configured step size and stops when two consecutive trials have zero frame loss (test succeeded in that case) or the minimum rate is reached (test failed in that case). For each trial, the report displays the frame loss ratio.
- **Back-to-Back:** The back-to-back test aims to measure the network's ability to absorb bursty traffic. The test runs at line rate less 200 Kbps, and bursts of Y.1731 TST frames are generated a configurable number of times. The duration of a burst is configured in milliseconds, and the time from one burst ends until the next starts is configured through the Dwell Time.

The tables that define parameters for the individual sub-tests appear and disappear depending on whether the test is selected or not.

## 6.3 Throughput Test Parameters

### Trial Duration

The time - in seconds - to transmit Y.1731 TST frames at one given rate and frame size. This is known as a "trial". Valid range is from 1 to 1800 with a default of 60 seconds.

### Minimum Rate

The minimum rate – in permille of the egress port's line rate – to transmit Y.1731 TST frames at. If a trial fails at this rate, the test fails. Valid range is from 1 to 1000 with a default of 800 permille of the line rate.

### Maximum Rate

The maximum rate – in permille of the egress port's line rate – transmit Y.1731 TST frames at while searching for maximum throughput. This is the rate that the search starts at. Valid range is from 1 to 1000 with a default of 1000 permille of the line rate.

### Accuracy

This specifies the stop criterion for the search for a maximum throughput rate. When the difference between a failing and succeeding rate is smaller than the accuracy, the search stops and the succeeding rate becomes the result. Valid range is from 1 to 1000 with a default of 2 permille of the line rate.

### Allowed Frame Loss

In some cases, it may be acceptable to have loss on a connection. The allowed loss can be specified with this parameter. The loss is measured in permille of the number of transmitted frames during a trial, so if allowed loss is set to e.g. 1 permille and 1000 frames is transmitted during a trial, the trial will be considered successful if 999 or 1000 frames return to the transmitter. Valid range is from 0 to 100 with a default of 0 permille of the number of transmitted frames.

A value of 5 would be 0.05% frame loss.

## 6.4 Latency Test Parameters

### Trial Duration

The time - in seconds - to transmit Y.1731 TST frames at a given rate and frame size. This is known as a "trial". Valid range is from 10 to 1800 with a default of 120 seconds.

### Delay Measurement Interval

This controls the period - in seconds - at which Y.1731 1DM frames are transmitted. The first 1DM frame is transmitted this number of seconds after the trial has started. The total number of transmitted 1DM frames in one trial therefore depends on the configured trial duration. Valid range is from 1 to 60 with a default of 10 seconds.

### Allowed Frame Loss

In some cases, it may be acceptable to have loss on a connection. The allowed loss can be specified with this parameter. A trial is considered failing if more than this percentage of frames are lost. Valid range is from 0 to 100 with a default of 0 permille of the number of transmitted frames.

A value of 5 would be 0.05% frame loss.

## 6.5 Frame Loss Test Parameters

### Trial Duration

The time – in seconds – to transmit TST frames at a given rate and frame size. This is known as a "trial". Valid range is from 1 to 1800 with a default of 60 seconds.

## **Minimum Rate**

The minimum rate – in permille of the egress port's line rate – to transmit Y.1731 TST frames at. Valid range is from 1 to 1000 with a default of 800 permille of the line rate.

## **Maximum Rate**

The highest (and first) rate – in permille of the egress port's line rate – to transmit Y.1731 TST frames at. Valid range is from 1 to 1000 with a default of 1000 permille of the line rate.

## **Rate Step**

The rate decrement – in permille of the egress port's line rate – per trial. Valid range is from 1 to 1000 with a default of 5 permille of the line rate.

## **6.6 Back-to-Back Test Parameters**

### **Trial Duration**

The time – in milliseconds – to transmit a burst of Y.1731 TST frames at line rate and frame size. This is known as a “trial”. Valid range is from 100 to 10000 with a default of 2000 milliseconds.

### **Trial Count**

The number of times to repeat the burst. Valid range is from 1 to 100 with a default of 50 times.



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