



# RTD measurements with Victoria

*Delay measurements are necessary in order to quantify the time it takes for digital signals to reach their destination. Delays appear in long paths, but they can also be found in transit between the ports of different nodes in a PDH or SDH network.*



Application Note VASDHRTD22e



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Delays in the time it takes for a signal to reach its destination are due to two factors: Long paths, and transit times through the network elements. Delay due to long paths depends on the design of the overall link. The transit time in network elements is due to the processing of signal frames inside these elements (e.g. reconstructing the frames in multiplexers, exchanging VCs in the DXCs, etc.). Data communications are particularly sensitive to this type of disturbance.

## DELAYS IN LONG PATHS

Delays due to long paths occur most commonly in intercontinental links that include sections via satellite. In these cases, variations in the position of the satellite cause frequency deviations and delays. When the delay exceeds a certain value, synchronization and signaling errors may occur. The connection may not even be made or may be lost during data transmission.

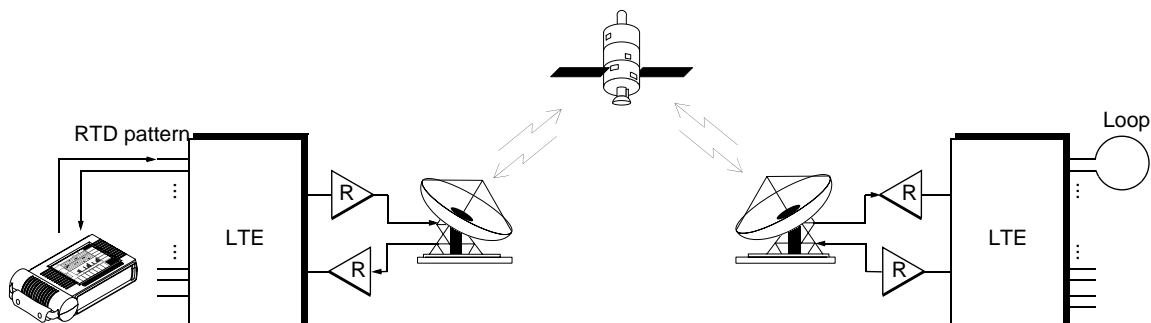
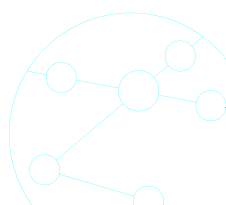


Figure 1

Measurement of RTD in a long path.

## TRANSIT TIME IN NETWORK ELEMENTS

When a link includes several multiplexers and DXCs, a noticeable delay may occur in excess of the maximum recommended limits. The transit delay introduced by these network elements depends on the processing they perform on the signals they receive. For instance, in an ADM the delay between the input of an STM-1 aggregated signal and the output



of one of its 2 Mbit/s tributaries through the corresponding port may be around 75  $\mu$ s. Every network element introduces delay in the signal it processes.

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## QUANTIFYING THE DELAY

ITU-T recommendation G.114 stipulates the maximum tolerable delay between the ends of a connection for the processing time. It does not include the part of the total delay that is due to the time it takes for the signal to reach its destination, since this depends on the rate of the signal transmitted by this means and the distance, and can only be controlled in a limited way by the network planners.

Transmission time (one way)	Application
0 to 150 ms	Acceptable for most user applications
150 to 400 ms	Acceptable whenever the influence of this time on the quality of the user applications (e.g. connections with satellite hops) is known
> 400 ms	Unacceptable for network planning

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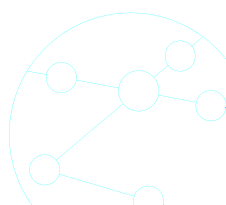
Table 1 Limits for end-to-end transmission time (ITU-T G.114).

In exceptional cases, times of more than 400 ms can be accepted; for instance, in double satellite hops, when satellites are used to restore terrestrial routes, interconnection of fixed satellite service, cellular telephony, etc.). It is recommended that the one way processing time from multiplexers, DXC and other network elements from each national system and the chain of circuits in an international connection be limited to 50 ms, although in real cases it tends to be much less (for instance, around 6 ms for a national system and 3 ms for the international chain).

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## CALIBRATING THE MEASUREMENT DEVICE

In order to ensure that the measurement is correct, the measurement device must be calibrated in such a way that it eliminates the quantification of delay caused by its own internal circuits. For this reason, delay must



be measured when the input and output have been connected via a short loop. The value obtained should then be subtracted from the delay measured in a path or a network element if we are to obtain the correct measurement. It may also be necessary to subtract the delay introduced by external elements (for instance, to eliminate the delay introduced by line terminal equipment) from the measurement to be made. In this case, the loop must be set up between the input and output of these external elements. This can be seen in Figure 2.

Depending on the instrument, the test signal used for measuring delay can be a fixed pattern or a PRBS in a PDH or SDH hierarchical line signal. The methods used for recognizing the pattern to end the time count also depend on the design of the measurement instrument.

Victoria incorporates the measurement of round trip delay as one of its functions. The range of delays it can measure goes from 1  $\mu$ s to 10 s. With the aim of ensuring a correct measurement, Victoria can easily be calibrated from the user interface, setting the delay to be eliminated to zero.

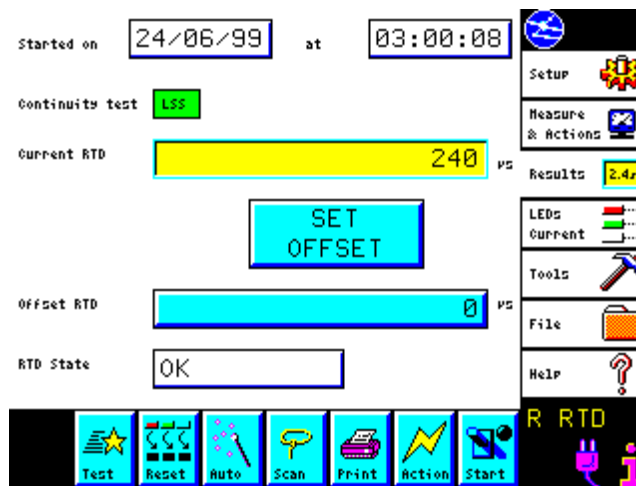
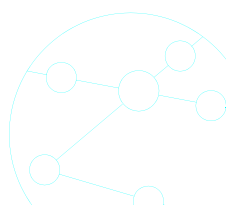


Figure 3

Screen for delay measurement and calibration on Victoria.

An offset can be set to calibrate the instrument. This is done automatically by pushing a graphical button.



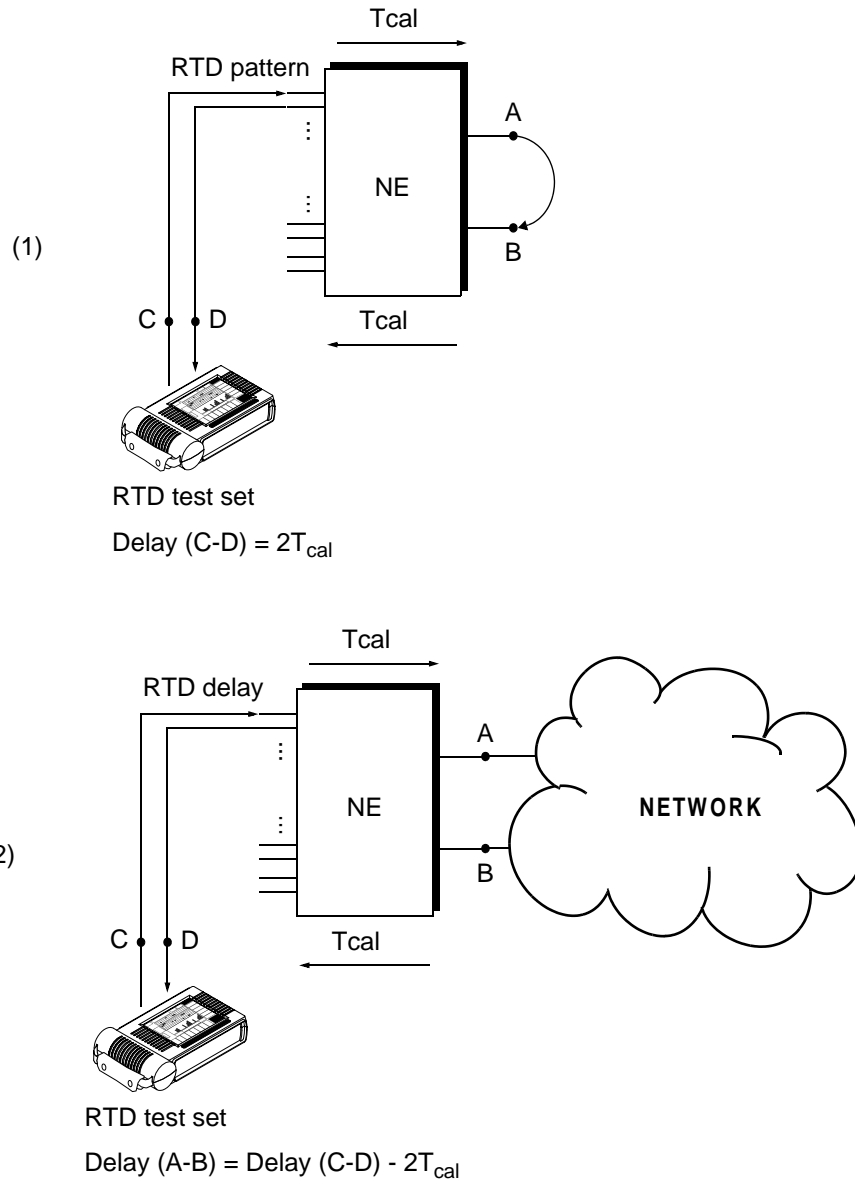
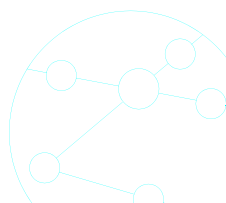


Figure 2

Generic calibration process and RTD measurement between A and B. (1) Measurement of delay introduced by element NE. (2) Measurement of delay between A and B from points C-D.

A previously known offset value can also be introduced directly. This is done immediately using the alphanumeric contextual keyboards on the GUI of the Victoria. □



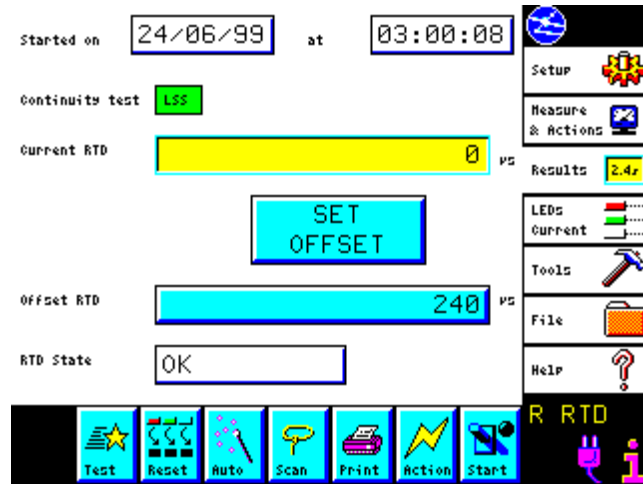
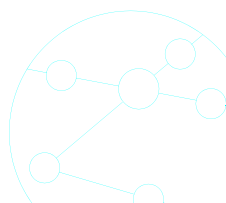


Figure 4

Automatic establishing of delay measured as offset of previous measurement.



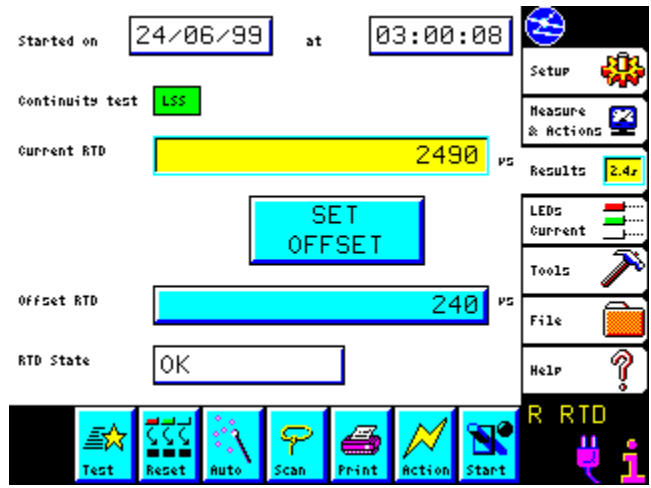
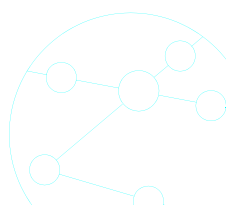


Figure 5

Manual introduction of a previously determined offset value.



**A**

ADM (*Add-Drop Multiplexer*) 2

**D**

DXC (*Digital Crossconnect*) 2, 3

**I**

ITU-T (*International Telecommunications Union  
Telecommunications*) 3

**N**

NE (*Network Element*) 4

**P**

PDH (*Plesiochronous Digital Hierarchy*) 1, 4  
PRBS (*Pseudo Random Binary Sequence*) 4

**R**

RTD (*Round Trip Delay*) 2, 4

**S**

SDH (*Synchronous Digital Hierarchy*) 1, 4  
STM-1 (*Synchronous Transport Module-1*) 3

**V**

VC (*Virtual Container*) 2



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