



TIE and frequency measurements

Victoria lets us see how a signal may fluctuate by measuring its frequency and phase, and evaluates wander - the prime cause of errors in SDH and SONET networks - by measuring the Time Interval Error (TIE).



Application Note ANVASOTIE21e



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Wander, the prime cause of errors in SDH/SONET transmission networks, is evaluated by checking the time interval error (TIE). Low quality synchronization sources or bad clock recovery leads to degradation of the signals transmitted, and this can be checked for by measuring line frequency. Both of these measurements can be performed by Victoria.

FREQUENCY MEASUREMENT

In order for the network to remain correctly synchronized, all signals must travel at a standard rate, which may vary slightly within the margins set by the corresponding ITU-T and ANSI recommendations.

Although in theory each signal has a specific nominal value, in reality it may drift slightly from this value and thus generate impairments. This makes it necessary to measure the line frequency and check to what extent this deviates from the nominal ITU-T/ANSI values.

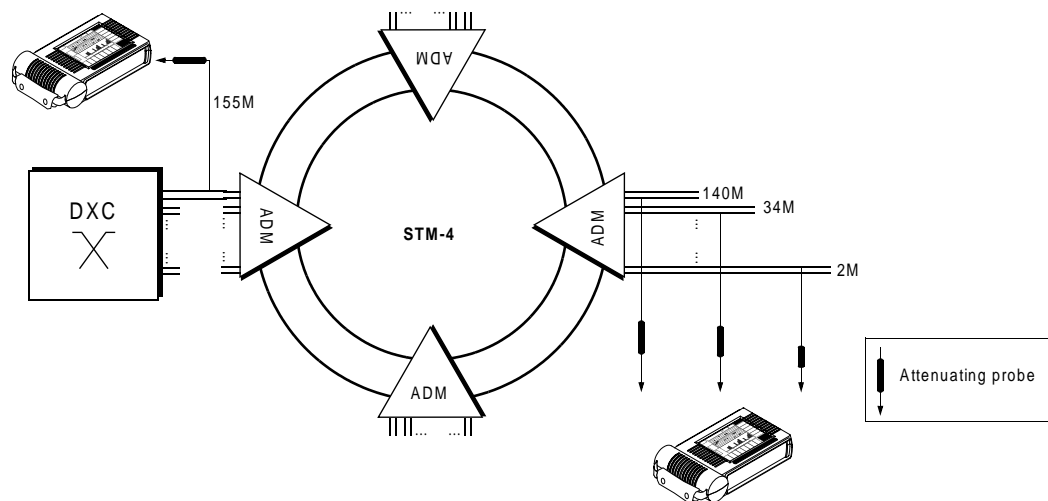
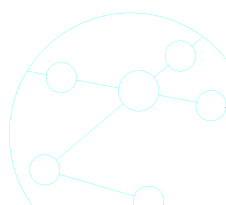


Figure 1

Frequency measurement

TIME INTERVAL ERROR (TIE)

TIE (Time Interval Error) is defined as the difference between the phase of a signal and that of its reference clock. This parameter is related to slow phase variation (less than 10 Hz), otherwise known as *wander*.



The TIE is set to zero at the beginning of the measurement and at the end we can see the change in phase that has taken place.

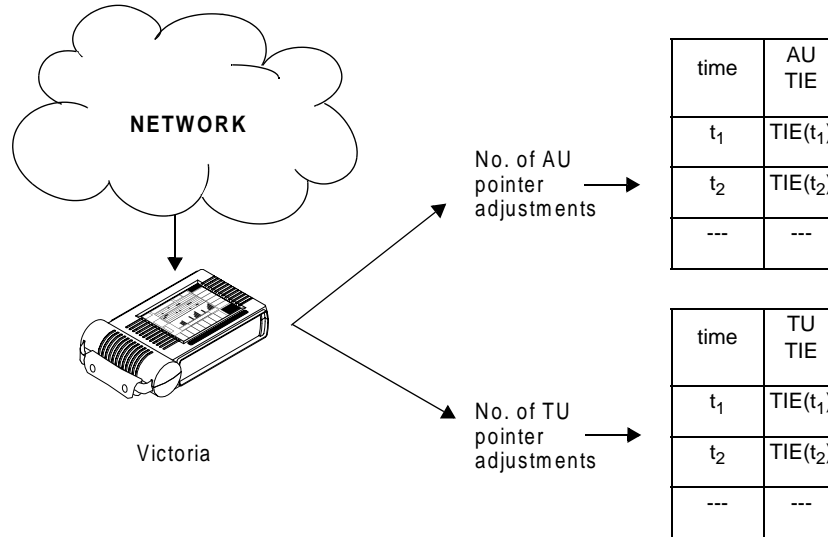


Figure 2

TIE measurement

Pointer adjustments are directly related to TIE: when an AU or TU pointer adjustment occurs, a phase offset is accumulated. This offset is expressed in ppm and is calculated as follows:

AU pointer increment: 24 bits

Bit rate for a VC-4: 150336 Kbit/s

Bit time for a VC-4:

$$T_{bitVC4} = \frac{1}{150336 \times 10^3} s$$

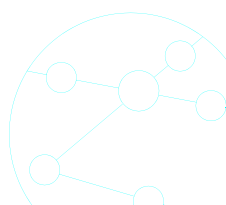
Since the AU pointer increases by 24 bits in relation to the VC-4 signal,

$$T_{24bitVC4} = \frac{24}{150336 \times 10^3} = 159,64 ns$$

The corresponding relative value expressed in parts per million (ppm) is calculated in the last second of the measurement:

$$OffsetAU_{ppm} = \frac{159,64}{10^9} \times 10^6 = 0,1596 ppm$$

Victoria performs signal frequency measurements for frequencies of 155, 140, 52, 45, 34, 8, 2 and 1.5 Mbit/s, with the offset given in ppm



together with an indication of whether or not it complies with ITU-T/ANSI recommendations.

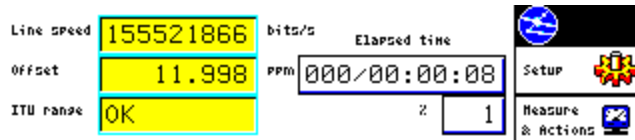


Figure 3

Screen showing line signal frequency measurement

It also carries out TIE measurements for AU/STS and SDH/SONET signals. □

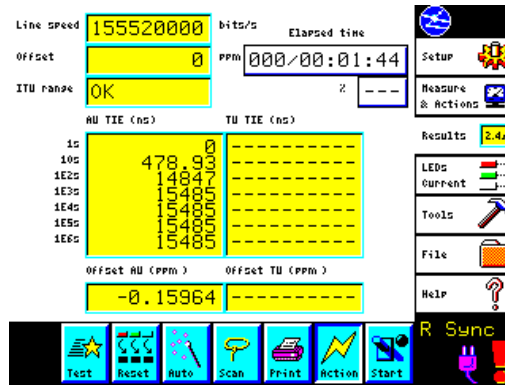


Figure 4

TIE measurement: example with SDH



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