
A version of the A031-ET Event Timer for KHz SLR

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About us

Institute of Electronics & Computer Science (IECS) has been founded in 1960 as a research institution of the Latvian Academy of Sciences. Since 1997 IECS is incorporated in the structure of University of Latvia. The accumulated in IECS knowledge and experience covers a broad area of the signal and data processing field, **including high-precision timing measurements for SLR.**



Our team* works in the area of SLR timing system development and production over many years (from 1970ies). Conventionally we attempted to meet the current demands to such systems of various potential users in view of their both actual and future needs. In this case a lot of different timing systems have been developed and custom-made, using Riga SLR station as a main proving ground.

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Leading specialists:

Dr. V. Bepal'ko (hardware designer)

Dr. E. Boole (ASIC/software designer)

Dr. A. Rybakov (software designer)

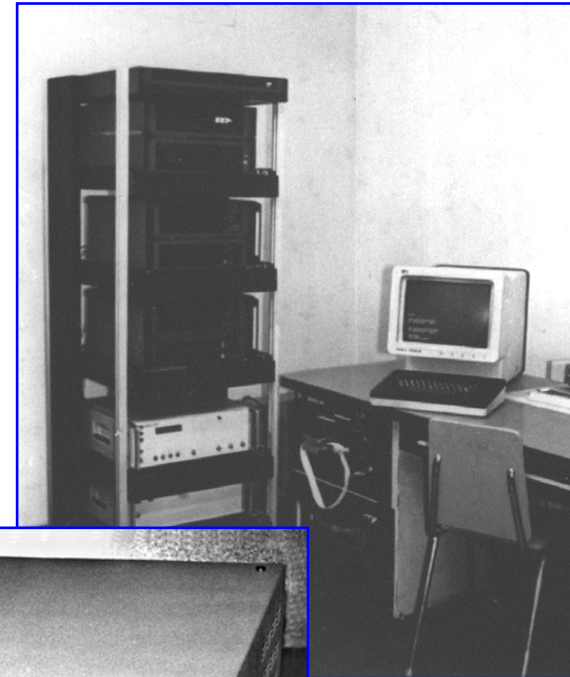
Dipl.-Ing. V. Vedin (hardware designer)



A few examples of the earlier developed Latvian timing systems for SLR

(1983) "PICAP" 3-channel Event Timer for Moon and Satellite Laser Ranging

Inputs: START, STOPs, EPOCH
Number of STOPs: 3
RMS resolution: 50 ps
Dead time: 50 ns
Max. TOF: 7 s
On-line programmable gating (12.5 ns LSD)
Internal real-time clock (200 ns LSD)
Measurement rate: 0.6 to 10 Hz

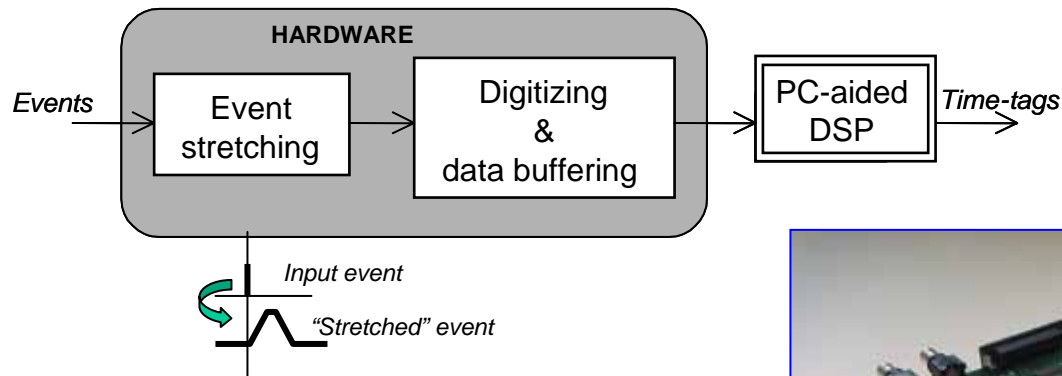


(1991) "COMTIS" 2-channel Event Timer for SLR

Inputs: START, STOPs, EPOCH
Number of STOPs: 2
Single shot RMS resolution: 30 ps
Range: 50 ns to 5 s
On-line programmable gating (25 ns LSD)
Internal real-time clock (200 ns LSD)
Measurement rate: to 100 Hz

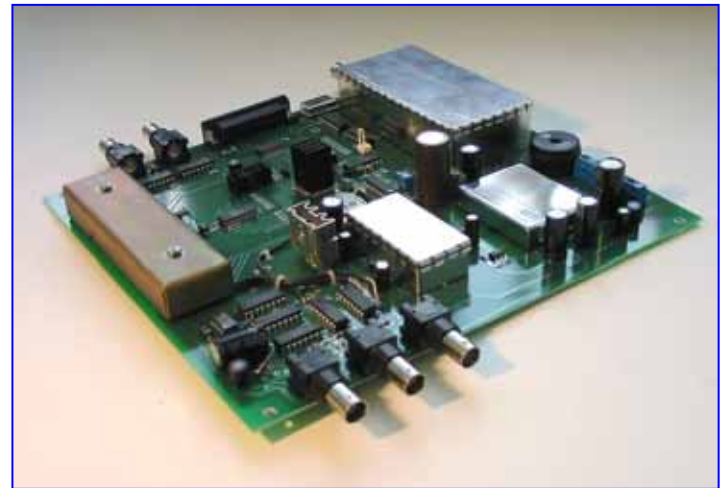


Developed in 1990-ies a novel method of interpolating measurement marked the beginning of new generation of Latvian timing systems that provide both high performance and relatively inexpensive technical solution



Main distinctive features:

- Event stretching instead of traditional time interval stretching, resulting in both small dead time and high precision of event measurement
- Emphasis on commonly available DSP facilities, resulting in relatively simple and inexpensive hardware design

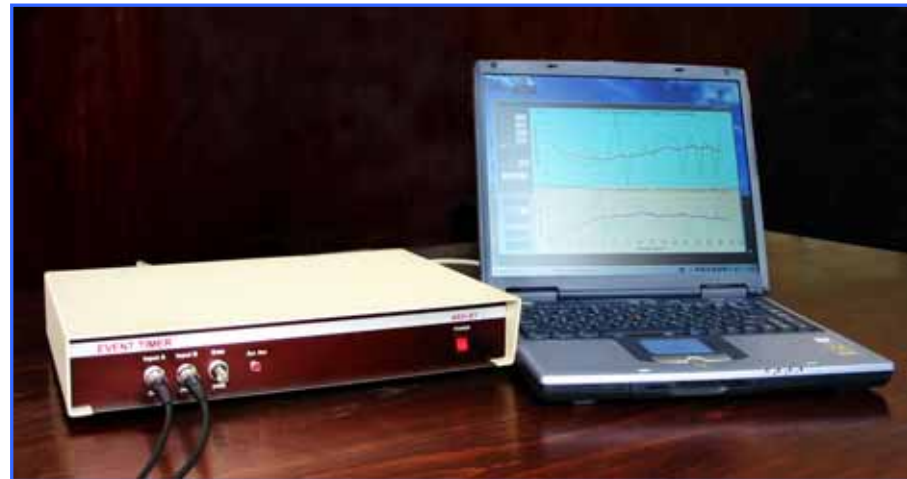


An example of hardware design

In 2003 we offered the latest timing system (Event Timer A031-ET) that was designed mainly for replacing the currently popular Time Interval Counter SR620. Compared to the SR620, the A031-ET supports both much better precision (first of all – in terms of non-linearity) and extended functionality at reasonable price.

A031-ET Event Timer

Inputs: START-STOP, GATE, EPOCH
RMS resolution: <15 ps
LSD resolution: 1 ps
Linearity: < ± 1 ps
Dead time: 75 ns
Max. TOF: 2 hr
Memory size: 6551 events
Cycle repetition rate: to 2 KC/sec



The basic A031-ET characteristics have been confirmed by the results of the A031-ET testing at Graz station (many thanks to Mr. G.Kirchner, Mr. L.Grunwald and others).

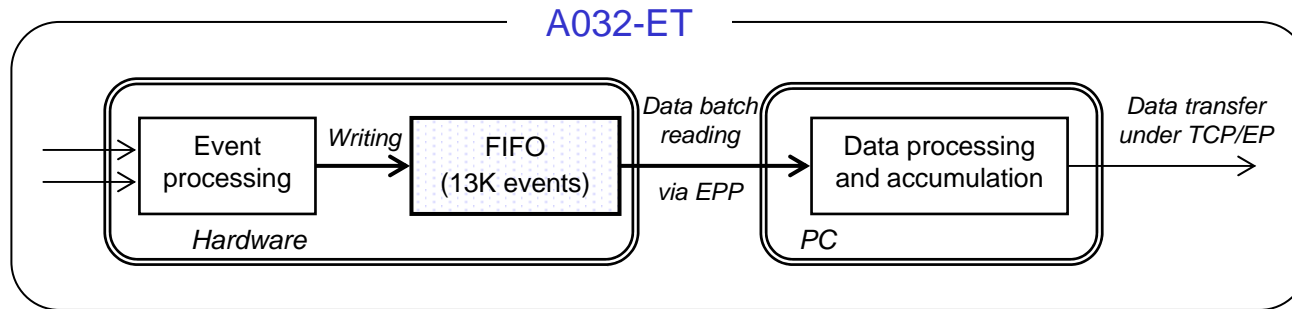
The problem to be solved

The A031-ET functional capabilities make it possible to measure not only single shot time intervals but also overlapped time intervals, as in high-rate SLR. However there is one limitation for such measurement: the A031-ET measures the events cyclically and needs some time gap between adjacent measurement cycles to transfer the currently accumulated data from the hardware to PC. The time gap duration depends mainly on the predetermined number of events measured in each cycle. For example, when 30 events are measured, the time gap is about 2.5 ms. In the case of SLR at 2 KHz repetition rate about 25% of events will be missed.

Although the mentioned limitation can be acceptable for SLR at lower repetition rate (up to 100 Hz approx.), we are developing a new version of the A031-ET tailored to KHz SLR. Further this version is designated as [A032-ET](#)

Solution of the problem

The hardware of the A031-ET has been modified so that the events can be recorded in parallel with accumulated data reading by PC due to FIFO memory using instead of previous RAM. In this case the maximum rate of continuous (gapless) event measurement is limited mainly by the maximum available speed of data reading via EPP (<100 μ s/Event).

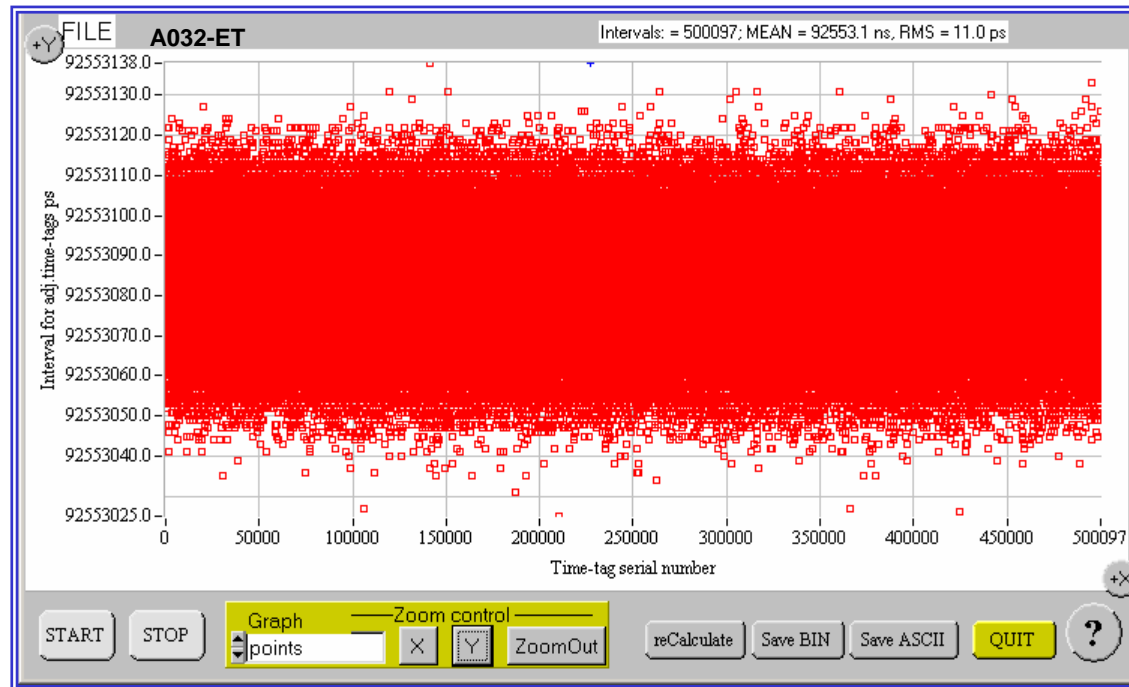


As for other functionality, the A032-ET will be almost similar to the A031-ET, except control; it will be available as fully remote.

Currently a pilot model of the A032-ET is in the stage of tests and software optimizing. It is expected that the device will be available for potential users in the beginning of next year.

A032-ET Preliminary Performance Characteristics

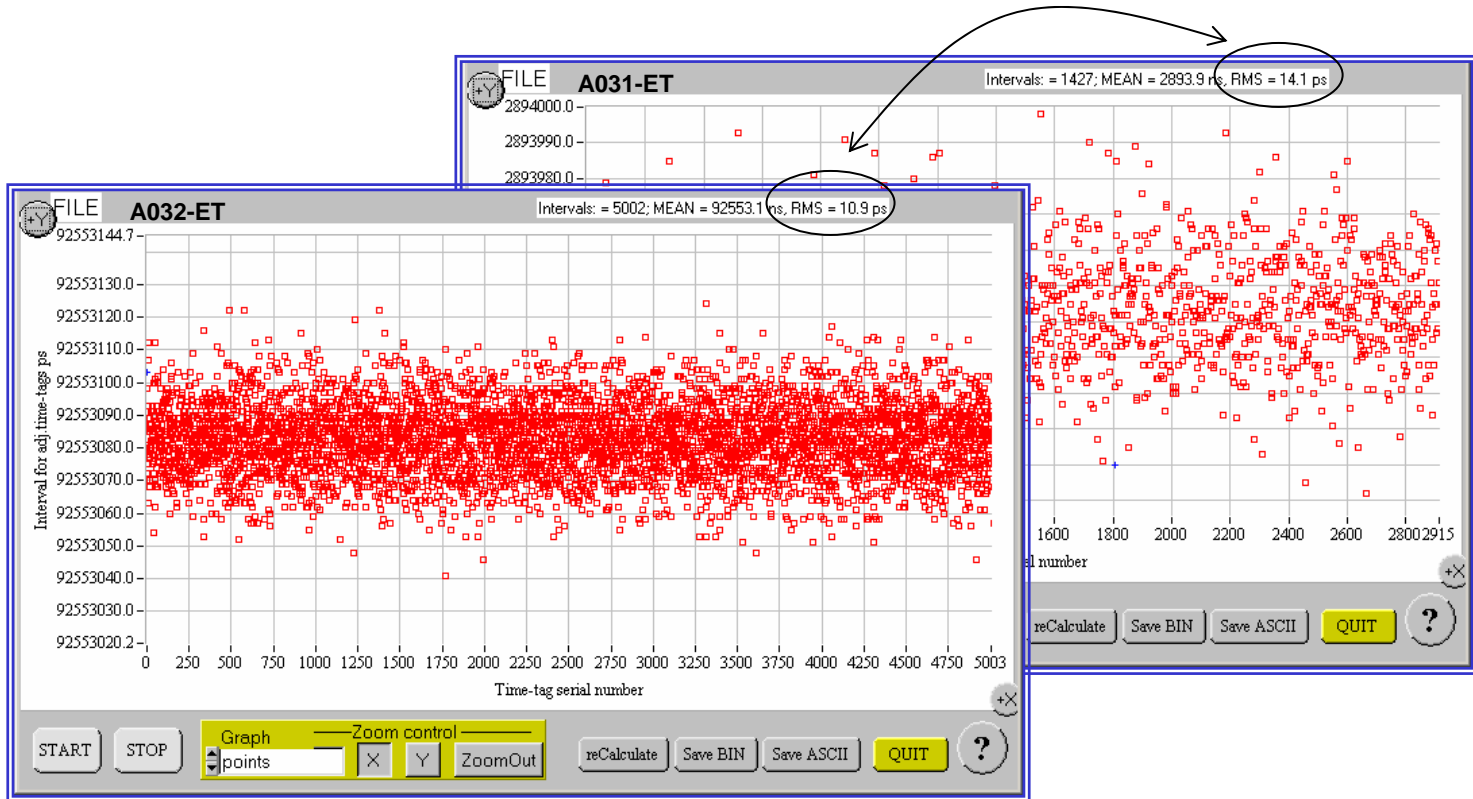
The A032-ET under test provides the maximum rate of continuous (gapless) event measurement higher than 10 KHz



Time intervals between adjacent events for 500,098 events measured continuously during 46.3 s at 10.8 KHz repetition rate. (100 Mbps LAN was used for data transfer to the remote A031-DS subsystem)

A032-ET Preliminary Performance Characteristics

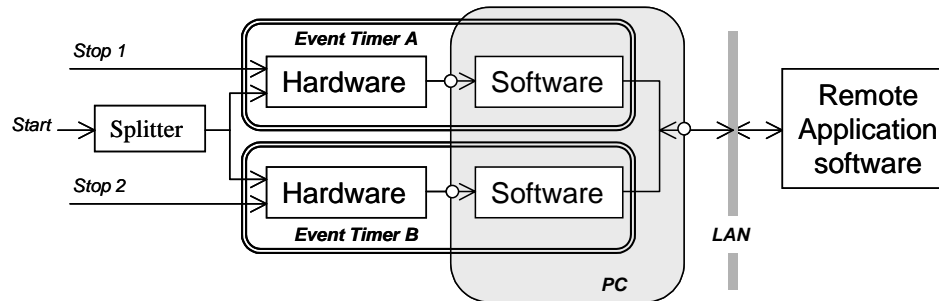
The A032-ET under test is almost similar to the A031-ET in accuracy, except RMS resolution; it is a little better due to more careful hardware design



Crystal pulse oscillator period measurement by the A032-ET and the A031-ET under nearly similar test conditions

A few questions for discussion

1. What should be added to the A032-ET features to make it most suitable for your possible applications?
2. Generally the A031-ET (A032-ET) can support two-color SLR, using the two separate event timer integrated in two-channel timing system.



As far as such systems are currently necessary? Are there any other special requirements to such systems?

3. In any case the transfer of time-tags from the event timer to a remote application will be performed with some delay. How large can such delay be for SLR applications?
4. We are also dealing with development of some additional tools for SLR timing systems such as low jitter test signal sources, delay generators, pulse amplitude measuring units, etc. What kinds of the similar tools are most necessary now?