

Modular Time Interval Counter

R. Szplet, P. Kwiatkowski, K. Róžyc, M. Sawicki, Z. Jachna

Electronics Department, Military University of Technology, Warsaw, Poland

Email: rszplet@wat.edu.pl

In laboratories involved in measurements and distribution of the reference time and frequency it is essential to monitor a quality of high-stable sources of clock signal (e.g. cesium clocks or hydrogen masers). This process needs continuous comparison of signals generated by the observed sources. One of the ways of performing this comparison is precise identification of time relation between 1PPS (*Pulse Per Second*) pulses coming from the sources. In this paper we present the design, operation and test results of a multichannel modular time interval counter that allows for simultaneous measurement of time relations between pulses 1PPS generated by up to six clock sources being under test and a single common 1PPS pulse from a reference, more stable clock. The counter contains six independent measurement modules (Fig. 1), built with the use of precise time counters integrated in programmable FPGA devices Spartan-3 manufactured by Xilinx¹. Integrated time counters are based on two-stage interpolation method that provides wide measurement range (> 1 s) and high resolution (< 45 ps). Their precision, calculated as a standard deviation of at least 200 measurements of constant time intervals within the range from 5 ns up to 1 s, is shown in the Fig. 2.

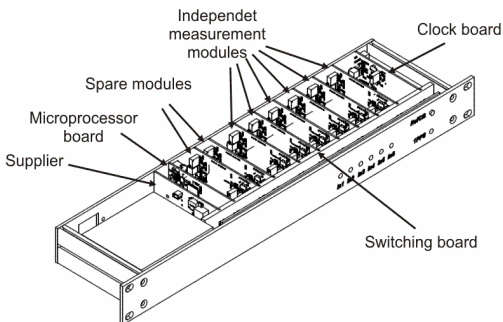


Fig. 1: Modular build of the time counter.

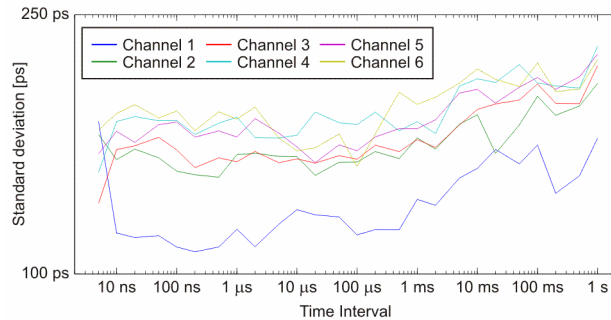


Fig. 2: Standard measurement uncertainty of six independent measurement modules of the counter.

Beside the time counter chip, each measurement module contains the wideband input channel forming a steep edge of input pulse and standardizing its amplitude. Measurement results are calculated by a control block based on raw data transferred from all measurement modules with the use of SPI interface. In addition, the control block allows for data exchanging between the modular time counter and an external computer that manages the measurement process and saves the data. The USB interface or Ethernet can be used for communication purposes.

The compact case of the time counter (1U rack-mounted unit) contains also spare measurement modules for maintaining the counter functionality in case of malfunction of any of original measurement module.

¹ R. Szplet, J. Kalisz, Z. Jachna: A 45 ps time digitizer with two-phase clock and dual-edge two-stage interpolation in Field Programmable Gate Array device, *Measurement Science and Technology*, 20 (2009) 025108.