Question: “What’s the best approach to perform basic measurements on a free-running clock?”

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I need to perform some basic measurements (frequency, jitter, rise/fall time) on a free-running clock. What’s the best way to do that?

Answer from Juergen Wolf, Verigy Germany

For free-running clocks your best choice is the Pin Scale per-pin time interval analyzer (ppTIA), which is available on any type of Pin Scale hardware (Pin Scale 400, Pin Scale 800 and Pin Scale 3600). Typically, ATE instruments like digital pins and also analog resources work best for test signals which are frequency-locked to the test system and also do not drift over time. The ppTIA does not have this restriction.

General principle of operation:

The ppTIA measures the elapsed time between a so-called event and the Nth event after that. We speak of an event whenever the signal to be measured crosses a certain threshold voltage. Events can be of the types ‘rise’ or ‘fall’ depending on whether the signal crosses from below or above the threshold voltage, respectively.

Frequency measurement principle:

By knowing the relative time between an event and the Nth subsequent event, we can easily calculate the clock signal period by dividing the measured time by N. Frequency is the reciprocal of period.

Jitter measurement principle:

The ppTIA can perform multiple single-period measurements. A statistical analysis of the resulting data gives you rms-jitter (standard deviation) and pp-jitter (max-min).

The time in between the individual measurements is determined by the ppTIA’s sample rate (Pin Scale 400: 650ksps, Pin Scale 800: 100ksps, Pin Scale 3600: 125ksps). Please note that the ppTIA’s jitter noise floor (JNF), i.e. the intrinsic instrument jitter, is typically ~25ps-rms and ~100ps-pp.

Rise/fall time measurement principle:

Rise/fall times are determined by measuring the time between two events of the same type (both rise or both fall) whose threshold voltages are set to the 10%-90% or 20%-80% voltage levels of the signal, respectively.

Code/setup:

For simple ppTIA measurements typically no additional changes are required in the setup, everything is handled by test method code.

Ready-to-use example code can be found in the SmarTest software under /opt/hp93000/soc/testmethod. Please note that starting with SmarTest 6.5 this code is automatically linked in and registered to any testflow and therefore directly selectable without any additional steps required.