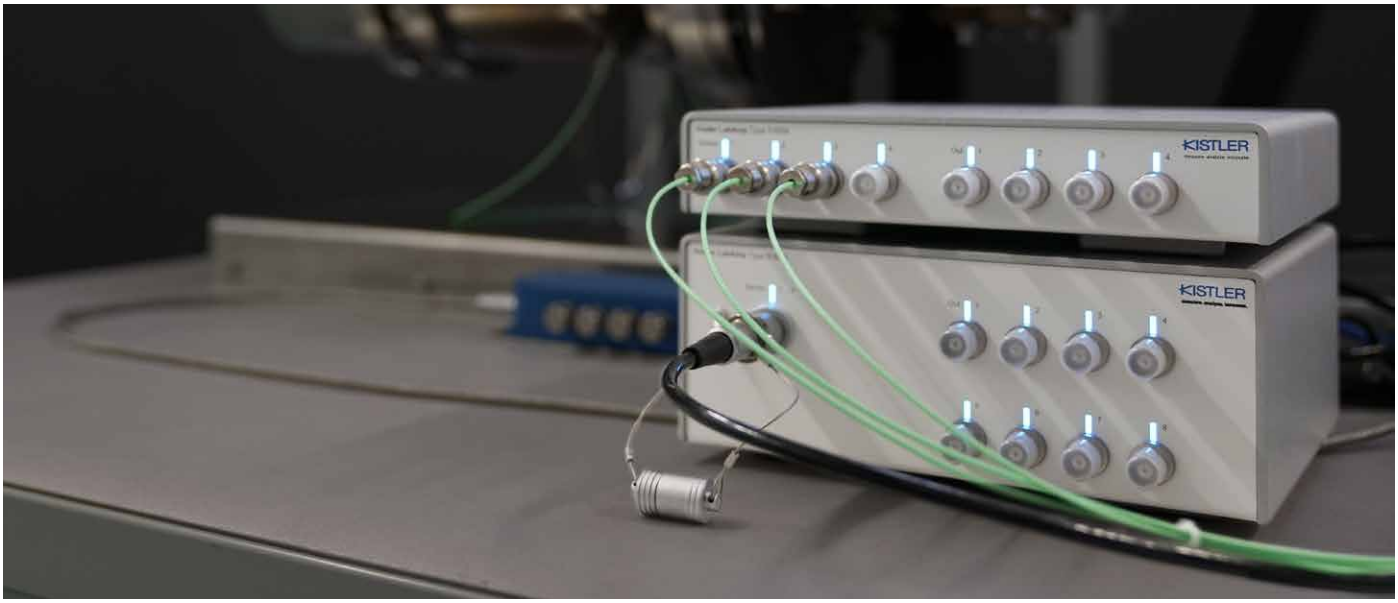

Example rocket propulsion test bench: PTP synchronized LabAmp Types 5167A and 5165A for 6-component force measurement and three pressure pulsation measurements to look for combustion instabil-ities in the combustion chamber

Synchronous measurements made easy

Automatic synchronization of DAQ devices with Precision Time Control (PTP)

Which measuring technician doesn't recognize this scenario: Today, three colleagues all need devices for different multi-channel measurements, tomorrow one has to cope with a bigger measuring task with even more channels. Thankfully this balancing act can now be elegantly managed with several synchronizable data acquisition (DAQ) devices. But, in practice, how does this actually work?

If one has to cope with repeated, identical measurements it's simple, a classical, tailored, high channel count measurement system is the accepted solution. However, what about when high flexibility is required, when you need to be able to switch between measuring many channels simultaneously or just a few, when you need the flexibility to be able to conduct completely different measuring tasks at the same time? Of course, this could be achieved by purchasing several identical data acquisition (DAQ) systems. However, due to the high costs involved, this solution isn't really an option to cover a more occasional need for a flexible system. If you switch to a cheaper solution, in addition to potentially compromising the accuracy of your results, you have to take into account the costs incurred familiarizing yourself with the operating philosophy, installation and getting to know other manufacturer's specific software. If, on the other hand, high-quality devices and software can be used flexibly for a wide variety of tasks, this significantly increases efficiency and also saves procurement costs. The basis for such a solution is intelligent, individual devices that can be combined to form a network.

Synchronization via PTP, an efficient solution

When it comes to the acquisition of measurement signals, it is absolutely crucial that they are synchronized, otherwise results may be interpreted completely incorrectly. Synchronization can be performed in two ways. The classic solution: A separate line where a system clock is routed to each device to ensure that the respective measured values (samples) are recorded at the same time. The other option is to equip each device with a precise clock and periodically adjust it.

The Precision Time Protocol, as described in the IEEE 1588-2008 standard, describes an ingenious procedure, whereby the clocks of local network components can be adjusted to achieve an accuracy in the sub-microsecond range — without additional cables. If measured values are now provided with this exact time value, the data acquired from multiple devices can be summarized on a superordinate computer, and displayed with precise timing, all thanks to the "time stamp".

What is Precision Time Protocol (PTP)?

The elegant thing about PTP is that the user does not have to worry about synchronization. The devices synchronize themselves automatically via the normal network cables. Only the topology must meet the requirements of PTP. For example, there cannot be any non-PTP-capable switches between the individual PTP devices, as these are unable to guarantee that data packets will always be forwarded at the same speed. To overcome this,

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Kistler LabAmp devices all have two network connections and integrated PTP switch functionality. Depending on the required data rate and number of channels, several devices can be connected in series without the need for an external PTP switch.

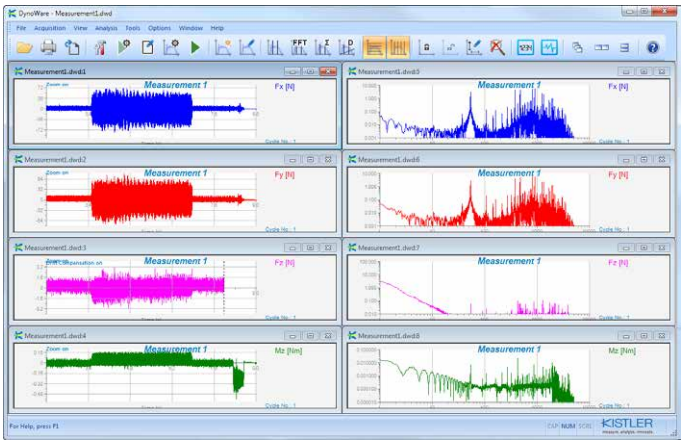
PTP recognizes two clock types: Master and slave. A slave synchronizes itself to its corresponding master. The most precise clock within a network is determined by the automatic "Best Master Clock Algorithm" (BMC). Once this "Grandmaster" is selected, the respective synchronization of the next slave takes place, which may in turn act as master for the next iteration. After a successful initialization, the synchronicity is checked at regular intervals and the clocks are readjusted if necessary.

Precision Time Protocol (PTP) in practice — application example with Kistler devices

There are differences in the quality of PTP implementation. The closer PTP is realized to the actual digitization of signals, the more precise the synchronization is. In Kistler devices, digitized measuring values receive their time stamps in a Field Programmable Gate Array (FPGA) directly behind the analog/digital converter, thus enabling precision in the sub-microsecond range.

Multiple 5165A and 5167A LabAmp devices can be integrated into a network for synchronized measurements. This allows, for example, quasi-static measurements with a piezoelectric dynamometer on a 5167A to be easily extended by adding a few voltage signals and an IEPE accelerometer, all just by adding additional, synchronized 5165A devices.

On the software side, various options are available. In DynoWare up to 16 LabAmp channels can be configured, synchronized, acquired, displayed and analyzed The Multi Device Client omits display and analysis, but in principle has no upper limit regarding the maximum number of devices. Via this route, channel counts in the three-digit range can easily be realized. Recordings can be started and stopped on a trigger basis — even in repetitive sequences if required. The collected data is conveniently available as a memory efficient binary file or, optionally as a CSV file, allowing it to be evaluated in any analysis tool.



With Kistler DynoWare, up to 16 LabAmp channels can be configured, synchronously recorded and analyzed.

Summary

With PTP, individual LabAmp devices from Kistler can be combined conveniently and cost-effectively to form a larger data acquisition system, without the need for additional synchronization cables. Synchronization happens automatically and with high precision. The collected data is conveniently available in a central file.

More information about the mentioned devices:
www.kistler.com/labamp

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