SHORTEN TIME IN ATE WITH TRIGGER-OUT

Automated test equipment (ATE) is a cornerstone in production facilities. Devices under test (DUT) have to be measured according to various limits to ensure safe and reliable operation for the user. A production facility must ensure that these tests are performed properly and cover all the necessary test cases. However, the tests must also be executed with sufficient speed. Oscilloscopes (e.g. the MXO series from Rohde & Schwarz) are often a typical part of ATE and can improve the workflow with a dedicated "waiting for trigger" signal.
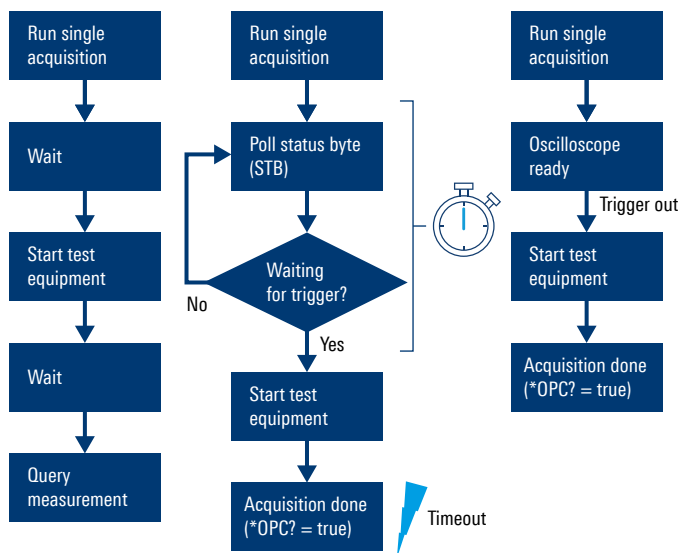
Your task

Designing and operating ATE for a production line can be challenging. Instruments from different vendors need to be controlled and maintained. Decreasing the test time is often a secondary but nonetheless necessary step.

Determining the readiness of a test instrument often requires polling status messages or simply waiting for the instrument. Oscilloscopes do not behave differently in this respect. An oscilloscope triggers an acquisition, captures the waveform, performs a measurement, etc. But finding out when an oscilloscope is ready for an acquisition is sometimes important and can speed up test time.

Rohde & Schwarz solution

Determining the readiness of the oscilloscope can be handled in three ways as described below. Oscilloscopes can improve the workflow with a dedicated "waiting for trigger" signal (see next page).

1. Waiting

The easiest but least elegant way is to simply add a waiting command in the script. This highly asynchronous[1] workflow requires arming the oscilloscope trigger, waiting for a certain amount of time, starting other test equipment, waiting again for a time during which the oscilloscope (hopefully) performs acquisitions and measurements, and then querying the data (see Fig. 1, left). Obviously, if the waiting time is too short, then incorrect results may occur, requiring the tests to be repeated, or contingencies may be needed in the control software for timeouts, etc. This method is easy to implement and may be used as a quick fix during development.

2. Polling

This method is more complicated to implement, but it generally ensures stable operation. Depending on the manufacturer, the status byte (STB) can contain important status conditions for the oscilloscope. Working with the STB typically requires some study of the instrument manual since the operation of the STB can be complex (see Fig. 1, middle). Important aspects include:
▶ Arming the instrument (RUNSingle, *OPC?)
▶ Polling STB for "waiting for trigger"
▶ Start other ATE
▶ Is acquisition done? (i.e. polling STB for OPC bit)

[1] In the context of automated test equipment, synchronization between the test instruments and control software is implied.

Fig. 1: Implementation methods for automated test equipment

Left: waiting; middle: software polling; right: trigger-out synchronization

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Make ideas real

A certain amount of effort is needed to study and implement polling. Nevertheless, in the absence of a hardwired signal, polling the STB may be the only good implementation method [2].

3. Trigger-out synchronization
A variation of the aforementioned workflow uses the standard commands for programmable instruments (SCPI) command "RUNSingle; *OPC?" immediately at the start. The first command arms the instrument, and the second command returns "true" once the acquisition is complete.

In this case, the "Waiting for trigger" polling sequence to synchronize other test instruments is not possible since execution of the program is halted until "true" is returned. This can lead to a potential virtual instrument software architecture (VISA) timeout error if the answer takes too long. It is also not possible to start other test equipment from the control software during this time. This limitation can be removed by using a dedicated (physical) trigger-out signal.

[2] In a multithreading architecture, synchronization via VISA WaitOnEvent is also possible. See the Rohde & Schwarz homepage for more information on the topic of "Measurement Synchronization".

Fig. 2: Trigger-out configuration dialog of the MXO series oscilloscopes
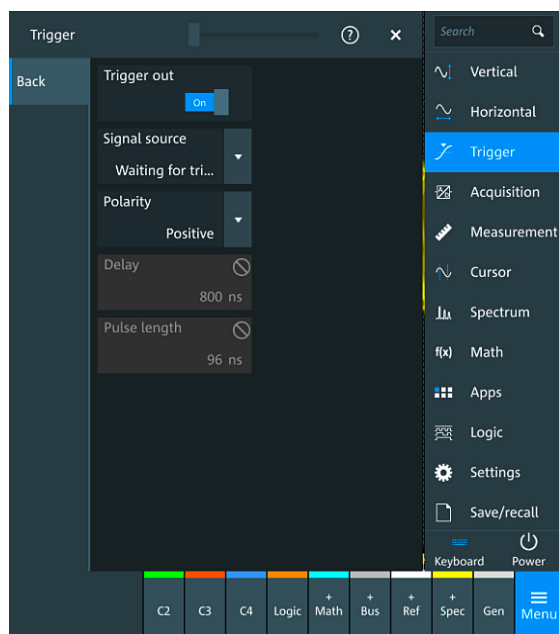
The MXO series oscilloscopes offer the possibility to configure the "waiting for trigger" status bit, which was previously available only in the STB, to be routed to the trigger-out port (see Fig. 2).

This trigger-out port is then connected to other instruments in order to signal them to start their operation (see Fig. 3).

Fig. 3: Synchronization of other ATE via a trigger out from the oscilloscope
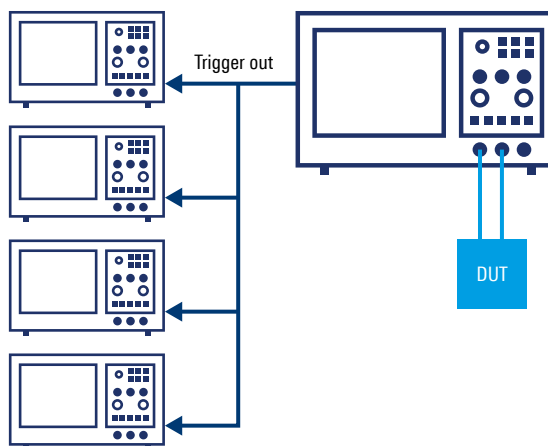
The programming workflow is shown in Fig. 1 on the right. The typical command "RUNSingle; *OPC?" arms the oscilloscope, the ready state is signaled via hardware. Once the acquisition is complete, the *OPC? returns "true" and the script continues.

Summary
Different methods are available to synchronize other ATE to the ready state of the oscilloscope. One way to circumvent obstacles related to the status byte and event status register (ESR) involves synchronizing the instruments via a physical "waiting for trigger" signal. This makes the whole setup easier to program and faster in execution. For this task, the MXO series oscilloscopes are very straightforward to use.