Memory organization on CompuScope Cards

Memory architecture

All CompuScope cards have high-speed dedicated on-board memory in which to store the digitized waveform data. After waveform acquisition, these data may be downloaded through the PCI bus to PC RAM, where the user may display, analyze and store waveform data.

Interface to the PCI bus

In order to allow optimum data transfer rates from the CompuScope card memory to the PC memory, the on-board RAM is mapped into the memory space of the PCI bus.

The PCI bus Plug-and-Play BIOS determines the exact address at which this memory is mapped. This means that the user does not have to set any jumpers or switches to configure the CompuScope card — it really is plug and play.

Bus Mastering

Full PCI bus mastering capabilities are provided on all CompuScope models, allowing the fast PCI data transfer to occur as a result of a Direct Memory Access (DMA).

Software loads the start address, destination pointer and number of points to be transferred into the PCI bus controller on the CompuScope card and then asks the card to do a DMA transfer. The PCI bus mastering control circuitry takes over from this point and performs the transfer without any CPU involvement. PCI bus mastering allows sustained data transfer rates from CompuScope memory to PC RAM that are as high as 200 MegaBytes/sec.

Data storage

The data coming out of the A/D converters or digital input is stored in the on-board memory buffer, which is configured as a circular buffer. A circular buffer is used to guarantee that the system will keep on capturing data indefinitely until a trigger event is detected.

The sequence of events is as follows:

- PCI bus instructs the CompuScope to start acquiring waveform data.
- BUSY flag is activated by the CompuScope. PCI bus is denied any further access to the on-board memory.
- The on-board memory counters initialize to ZERO and start counting up, thereby starting data storage at memory address ZERO.
- The system waits for a trigger event to occur while it is storing data in the on-board memory. This data is called Pre-Trigger data.
- Once the trigger event occurs, a specified number of Post-Trigger points are captured. The number of Post-Trigger points has been previously specified by selecting the post-trigger *Depth* from software.
- After storing the specified number of Post-Trigger points subsequent to receiving the trigger event, acquisition is stopped, the BUSY flag is deactivated and the PCI bus is allowed access to the on-board memory.

A graphical representation of the above sequence is as follows:

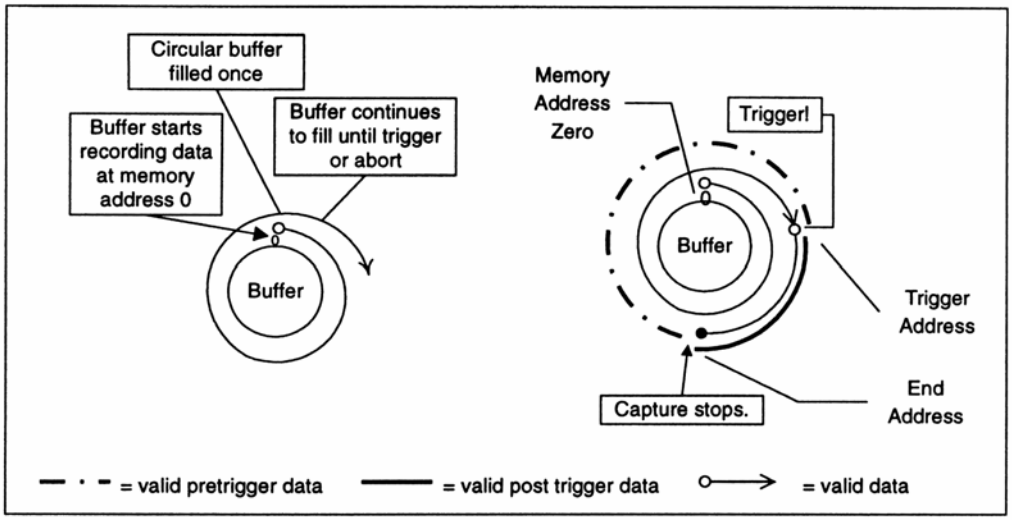

Figure 1: Pre-Trigger: all data points in buffer valid

In the diagram above, the circular memory buffer is shown as a ring with the physical memory address ZERO at the top. Data storage is shown as a spiraling line going clockwise.

Storage starts at address ZERO and keeps on writing into the memory until it is filled (the spiraling line completes a circle) and then starts overwriting the data stored in addresses ZERO, 1, 2...

Once a trigger event is detected, the address to which the data was being written into is tagged as the Trigger Address. Next, a specified number of Post-Trigger points are captured and then the acquisition is stopped.

The memory address at which the acquisition is stopped is designated as the *End Address* and the address after that one is called the *Start Address*.

Pre-Trigger data lies between Start Address and Trigger Address, and Post-Trigger data between Trigger Address and End Address.

It is clear from the diagram shown above that memory address ZERO is not necessarily the first point, or Start Address, of the signal being captured. In fact, the physical address ZERO has very little significance in such a system, since the trigger event can happen at any time.

One case in which ZERO is the Start Address is when the acquisition is completed before the memory had filled up, i.e. the trigger was received right after the software tells the CompuScope to start acquiring waveform data.

This situation is illustrated below:

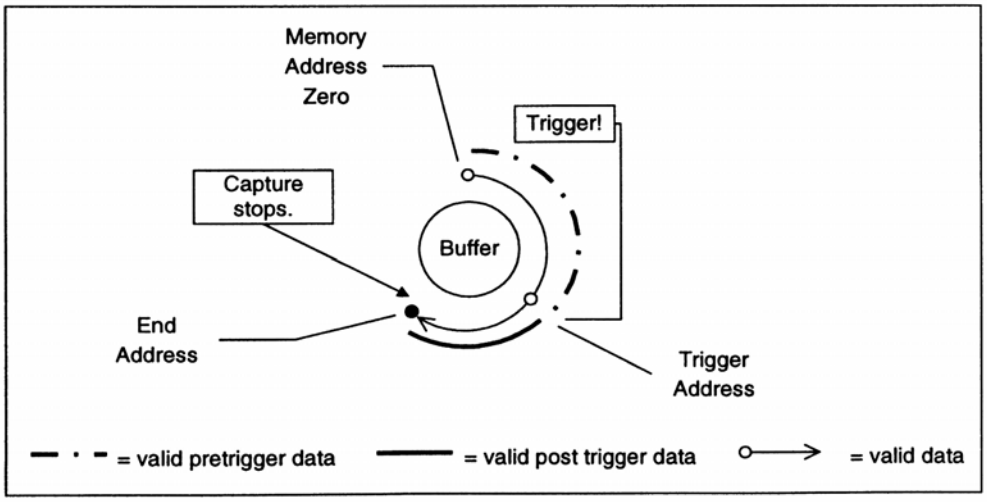

Figure 2: Pre-Trigger: not all data points in buffer valid

In this case, Pre-Trigger data still lies between Start Address and Trigger Address, and Post-Trigger between Trigger Address and End Address. The only difference is that the start Address is ZERO and is not one point after the End Address.

The CompuScope driver and the Software Development Kits seamlessly manage both acquisition sequences illustrated in Figure 1 and Figure 2.