THE POWER OF PCI BUS INSTRUMENTATION

A White Paper on the Emerging Standard for

Test & Measurement

Data Acquisition

and

Instrumentation

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PCI BUS - WHAT IS IT?

PCI bus is a 32 bit, multi-mastering synchronous bus found in almost all PCs sold today. In fact, within the last year or so, PCI bus has become a dominant force in home and business computing.

The reason why computer manufacturers accepted PCI with such open arms is very simple: consumers wanted faster screen refreshes on their computer monitors and the ISA or EISA bus was not fast enough. After a brief challenge from VL bus, PCI emerged as the obvious answer.

Even before the PCI bus was adopted as the de facto standard for video cards in computers, computer manufacturers had found many other uses for it: EIDE and SCSI controllers for faster disk accesses, Ethernet cards for faster LAN/WAN applications, ATM cards, Frame-grabbers, etc.

PCI BUS AND INSTRUMENT MARKET

Another industry which benefited from the emergence of the PCI bus was the Test & Measurement and Data Acquisition industry.   Some also refer to this as the Instrument market.

The Instrument market has been searching for a reliable, high performance bus system for over a decade: CAMAC, MultiBus, VME, VXI and ISA are all examples of the desire of Instrument manufacturers to have a standard instrument bus which allows them to build an "Instrument-on-a-Card."

Unfortunately, the major Instrument manufacturers were not able to arrive at a consensus on a standard because competitive pressures forced them not to cooperate. The failure of the VXI bus has become a classic example of how multi-vendor standards can fail due to such reasons.

While the PCI bus was not developed for the Instrument market, it has all the qualities required of such a bus: standard and stable bus specifications; fast throughput for data sharing between instruments; multi-master capability for instruments to take complete control of the bus, when needed; reliable operation proven by millions of machines around the world; powerful standard operating systems such as DOS, Windows 3.1, Windows 95 and Windows NT; low cost software tools; reasonable platform cost, etc.

RIDING THE WAVE

PCI based Instrument vendors are riding the wave created by the consumer demands for more powerful computers. Computer giants such as Intel and Microsoft have invested billions of dollars into building today's PCs and recoup this investment by selling large quantities to the huge business and home computing market. No instrument manufacturer could have justified building such complex microprocessors and operating systems to serve only the Instrument market.

For example, thousands of man-years of engineering time went into the design of Pentium and Pentium Pro processors which enable complex software to run quickly enough to provide an instrument user the ability to visualize and analyze the data he or she measures at speeds faster than they have ever seen. A good example is one of the hard disk manufacturers who was able to reduce the test time for a typical suite from 8 seconds to 900 milliseconds by switching from a GPIB-controlled Digital Storage Oscilloscope to a CompuScope "Instrument-on-a-Card" from Gage.

Similarly, the powerful and reliable Solaris operating system formed the backbone of an internet-controlled oscilloscope based on another CompuScope product, which replaces the need for a medical equipment manufacturer to send out technicians on a quarterly basis to 400 locations around the world to certify the safety of their machines.

ISA BUS BASED INSTRUMENTS - A sign of things to come

The power of PCI bus Instrumentation is not only because of the good qualities of the bus. Vendors such as Gage Applied Sciences of Montreal, Canada have a great deal to do with the ready acceptance by the Instrument market.

Gage Applied Sciences has been manufacturing high quality, ultra-fast ISA (PC AT) bus based data acquisition products for the past 10 years. These products include the CompuScope 8012, the world's fastest 12 bit A/D and oscilloscope card and the CompuScope 2125/ETS, a 2 GS/s, 250 MS/s A/D and scope card.

These products feature very high Signal To Noise Ratio (SNR), Total Harmonic Distortion (THD) and Spurious Free Dynamic Range (SFDR). In fact, the overall performance of these CompuScope cards is better than comparable stand-alone oscilloscopes or transient recorders.

As a result of this level of performance on the ISA bus CompuScope cards, the Instrument market was ripe for the arrival of a PCI bus "Instrument-on-a-Card" in 1995 when the CompuScope 6012/PCI was launched by Gage.

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CompuScope 6012/PCI quickly became extremely popular with the Manufacturing Test industry. To name a few: Hard disk manufacturers such as Seagate, Quantum

and IBM adopted it; Television manufacturers such as SONY and Samsung adopted it; and Automobile manufacturers such as Ford and Chrysler adopted it.

A slew of other 12 bit PCI bus CompuScope products were released by Gage in 1996, featuring sampling speeds up to 80 MS/s, streaming to PC memory at 120 MB/s, direct-to-disk data acquisition at 5 MS/s, real-time acquisition and signal processing for radars and many other unique features found only in highly specialized or custom test gear.

FUTURE OF THE ISA BUS

The fast emergence and wide acceptance of the PCI bus is not completely replacing the reliable and proven ISA bus. The need for large number of slots for multi-card and multi-channel applications is still being fulfilled by the ISA bus.

In fact, the industrial computer industry has recognized this fact and has developed PICMG compliant backplanes which allow both ISA and PCI slots on the same backplane.

COMPUSCOPE 8500 - The first of a new generation of PCI Bus Instruments

In January 1997, Gage Applied Sciences, Inc., introduced the CompuScope 8500, the world's fastest A/D and oscilloscope board for the PCI bus.

CompuScope 8500 is PCI bus compatible, 8 bit A/D card capable of sampling at rates up to 500 MS/s (Million Samples per Second), i.e. 2 nanoseconds per sample.
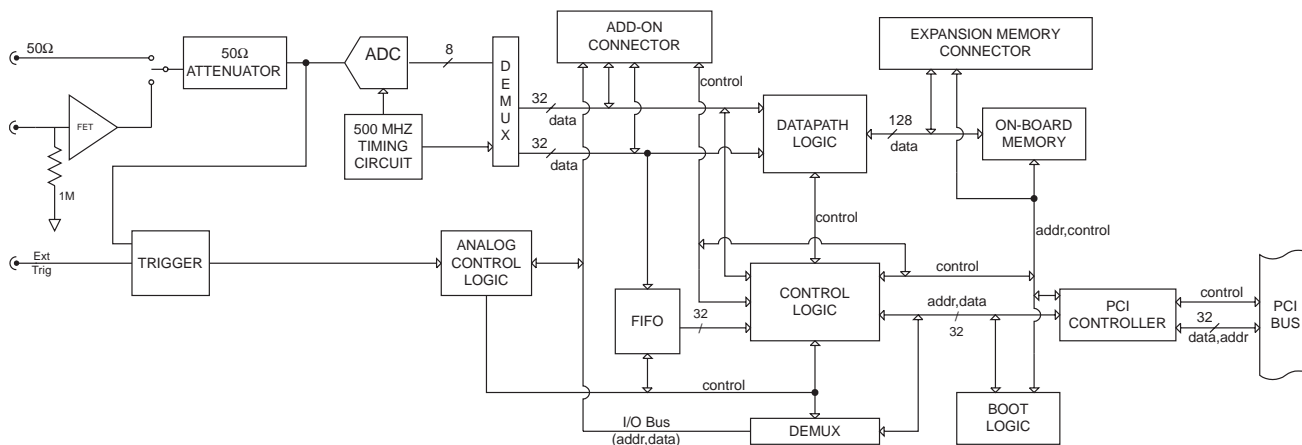
Key features of the CompuScope 8500 include:

- 500 MS/s sample rate for on-shot signals
- PCI bus interface, including Bus Mastering
- 8 bit vertical resolution
- Up to 8 Megasamples of on-board memory
- Transfer A/D data to PC Memory at 100 MB/s
- Programmable input gain and coupling
- Internal or external trigger capability
- Drivers for DOS, QNX, Win 3.1, Win 95 and Win NT
- Oscilloscope-like analog front-end
- No GPIB or IEEE-488 bus required
- GageBus Add-on Connector for future A/D and D/A Daughter Boards

Gage uses highly reliable, Flash A/D chips to do the 500 MHz sampling. The result is that a very high Signal To Noise Ratio (SNR) of 45 dB is achieved along with a DC to 250 MHz bandwidth on a repeatable basis.

At the 500 MHz sampling rate, CompuScope 8500 stores the digitized data in on-board memory. Memory buffers of up to 8 Million samples are available.

CompuScope 8500 takes full advantage of the fast data throughput offered by the PCI bus. Using Bus Mastering, data can be transferred from the on-board memory

to the PC's memory at rates up to 100 MB/s - more than 100 times the ISA bus throughput and more than 1000 times faster than GPIB!

For sampling rates lower than 100 MS/s, CompuScope 8500 is also capable of writing the A/D data directly to the PC's DRAM, instead of storing it in the on-board memory. This allows for memory buffers as deep as 1 GigaByte!

An on-board, high speed FIFO allows the CompuScope 8500 to keep on streaming data to PC memory, even during bus latencies, i.e. the time during which the PCI bus is disengaged from the CompuScope card.

The GageBus Add-on connector allows for future GageBus compatible A/D and D/A daughter boards to be plugged into the CompuScope 8500 board for additional capability. A variety of these cards will be offered throughout 1997-98.

CompuScope 8500 comes with FREE award-winning GageScope software which enables users to operate the card like an oscilloscope without writing a single line of programming code. It also allows users to store, analyze and print their data and to convert it to an ASCII format for export to spreadsheets and mathematical software packages.

Gage provides software drivers in all popular operating systems, such as MS-DOS, DOS/4GW, QNX, Windows 3.1, Windows 95 and Windows NT. These drivers can be used to control all the parameters of the CompuScope 8500, capture data and transfer it to the PC using bus mastering.

All popular compilers are supported by these drivers, including Borland C, Microsoft C, Watcom C, Quick BASIC, Visual BASIC, Visual C++, Borland C++, Delphi and many more.

Drivers are also available for use with LabVIEW, LabWindows/CVI, MATLAB and HP VEE programming environments.

Typical applications of the CompuScope 8500 include Disk Drive Testing, Lightning testing, Cellular communications, RF Receivers, Radar, Lidar, Imaging, Non-destructive testing, Ultrasonic testing, Laser Doppler Anemometry, High-end video, CCD testing, vibration analysis, laser diode characterization, impact testing, etc.

CompuScope 8500 - 128K will be available at the price of C$6,995 starting in February, 1997. Software drivers for DOS, QNX, Windows 3.1, Windows 95 and Windows NT are priced at $250 each. LabVIEW, LabWindows/CVI, MATLAB and HP VEE drivers are also priced at $250 each.

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