



SAMOS™: Multi-channel Acoustic Emission System

advanced • parallel processing • flexible, yet user friendly

Standard PCI Technology

The PCI-8 "8-Channel AE System on a Board" with "simultaneous" real time Digital Signal Processing (DSP) of Acoustic Emission (AE) waveforms and features is the "central" component in Physical Acoustics' SAMOS™ series of Multi-channel AE systems. Multiple PCI-8 cards form the "Sensor based Acoustic Multi-channel Operation Systems" (SAMOS™) that represent the latest generation of advanced AE systems by PAC. Such systems are tailored for low power and extreme compactness.

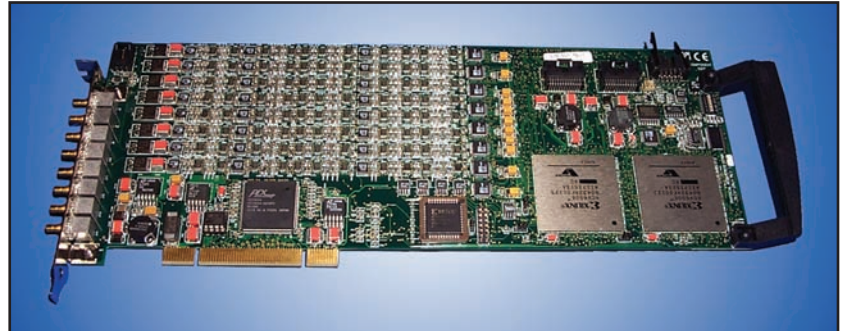


Figure 1. PCI-8 Eight-Channel Acoustic Emission System on a Board

SAMOS™ Workstations

...advanced and affordable

PCI-8 Subsystems occupy one full-size PCI slot in a computer chassis and can be implemented inside most standard PC's or inside one of PAC's four (4) rugged, multi-channel SAMOS™ system chassis, including SAMOS™ 112/48/32 and μSAMOS™. Such systems are based on PAC's known parallel processing architecture, processing simultaneously waveforms and AE features and are extremely cost competitive for today's advanced digital AE market. As with all other PAC systems, SAMOS™ multi-channel systems are powered by the AE experienced based Windows AEwin™ Software Suite operating at outstanding waveform/features AE hit data rates.

... SAMOS™ 32

The SAMOS™ 32 AE system is geared for laboratory or industrial use, holding up to 4 PCI-8 cards for up to 32 AE channels of operation. Based on a heavy-duty industrial PC computer chassis, the SAMOS™ 32 has added features for reliable day-to-day operation, including extra cooling, ventilation and the latest powerful PC computer. The most economical, high performance AE system available today, the SAMOS™ 32 is ideal for users with tight system budgets.

Retaining all the features of a full size AE system, including activity Hit LED's on the front panel, the system is also designed to utilize our digitally controlled, full-featured, high fidelity audio monitor (optional). It measures 17"W (43cm), 17"D (43cm) and 6"H (15.2cm), and weighs 26 lbs.

... SAMOS™ 48

SAMOS™ 48 is a portable AE system, equipped with a handle for carrying and an integral

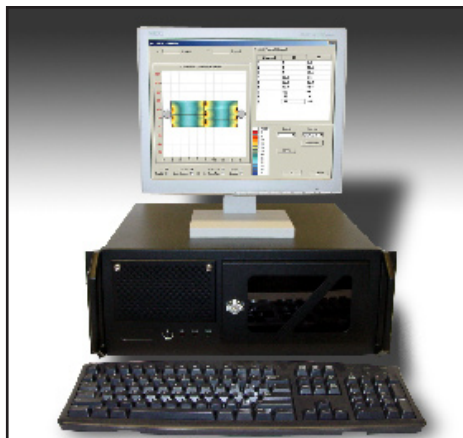


Figure 2. SAMOS 32 AE System

keyboard built within the hinged front protective cover. Weighing less than 38 pounds with all 48 channels, the SAMOS™ 48 is 21" long x 14" wide x 7.6" tall. Inside this portable enclosure is a powerful PC computer, large hard disk, floppy drive, R/W CD/DVD drive and the standard complement of parallel printer port, serial port, USB and mouse port. Built-in AE features include a digitally controlled audio monitor, up to 8 parametrics and AE Hit indicator LED's. Expansion and communication options include Ethernet LAN option and optional modem for remote control and communications purposes. Both Internet and Intranet software and interfaces are available.

... SAMOS™ 112

SAMOS™ 112 is a large capacity 112-channel system and represents the industry's largest number of AE channels in a single enclosure.

Key Features . . . of all SAMOS Systems

- Compact 32 or 48 or 112 channels of simultaneous DSP based AE waveforms and features in real time
- Operate under advanced AEwin™ Windows software
- Individual 16-bit A/D's on each channel
- PCI Bus for high speed processing
- LAN interface included with optional network and Internet monitoring capabilities available
- 400 kHz bandwidth
- Low power consumption, runs cool
- Acousto/Ultrasonic systems applications
- ISO-9001 certified and CE marked with low noise
- LED AE activity and "Super Audio"



Figure 3. SAMOS-48 AE System

The system comes equipped with an advanced PC based CPU and all standard peripherals including a LAN connection. Multiple cooling systems make SAMOS™ 112 a rugged multi-channel system especially for demanding applications in harsh environments.



Figure 4. SAMOS-112 AE System.

User Friendly. . . by Design

- Front Panel activity lights provide status on AE data as well as to give you a system diagnostic
- All digital, full-featured **Audio Monitor** built in and ready for “high fidelity” listening (*optional*).
- **Auto Sensor** testing (AST) standard with all PAC systems for easy system/sensor self calibration and interface coupling efficiency.
- Software available for the SAMOS™ includes the state-of-the-art **PACwin™ Software** with 25 years of Acoustic Emission application experience behind it, this Suite is comprised of three individual software packages (*purchased separately*). (*Software Development Kit*) which allows you

to develop your own software and programs in lab view or C/C++ giving you full control of acquisition and digital signal processing for your special application needs.

System Flexibility. . . by Design

Standard 32-bit PCI hardware and 32-bit software allow the customer maximum flexibility of using a PC or a notebook computer. No need to change home made PCs, but ability to take advantage of today's PC speeds readily available with high-performance PCI busses. Multiple AE channels are easily synchronized for multiple location algorithms.

Typical SAMOS™ AE Software

- 32-bit Windows Software (Win98, ME, 2000 and XP)
- Acquisition or Replay. Can run multiple sessions (Acquisition and Replay at the same time)
- Uses all Windows resources including printing, network, multi-tasking, etc.
- Play your existing DTA files from previous PAC AE systems
- Multiple Graph types including 2D, 3D (fully rotatable), line plots, point plots, histograms, multiple plots within a graph, waveforms, FFT's, and more
- Arrange multiple graphs on a screen (as many as you like) and create multiple screens using named windows labs
- Zooming, panning, cursor readout
- Location modes (Zonal, Linear, Planar, 3D-LOC)
- Hit and Event linking of data to other graphs

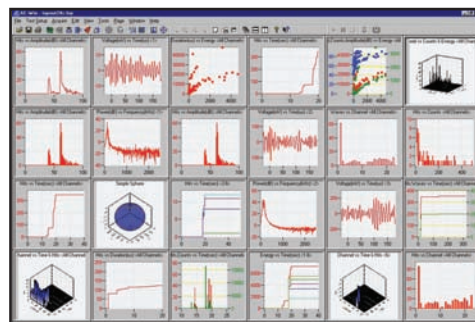


Figure 5. Many graphs per screen can be viewed in real time or replay. This screen shows some of the flexibility of AEwin™. In this overview, 2D and 3D graphs, waveforms, FFT's, line graphs, histograms, multi-plot graphs, etc. are shown.

Key Features . . .of the PCI-8 boards used SAMOS Multi-Channel AE Systems

- 8 complete (16-bit A/D) digital channels of AE features and waveforms on a single PCI card.
- PCI-bus provides AE data transfer rates of up to 132 Mbytes second to a PC computer.
- 4 High Pass, 4 Low Pass filter selections for each channel, totally under software control.
- Up to 2 parametrics on each PCI-8 board with update rates up to 10,000 readings/second (when attached to hit data.)
- Hit LED drivers are built within the PCI-8 board, so that AE activity LED's can be attached directly.
- Uses industry standard SMB connectors for sensor/ preamplifier outputs.
- Built-in AE feature extraction provides high speed transient data analysis at high hit rates.
- Designed with multiple FPGA's and ASIC IC's to provide extremely high performance and to minimize components and cost.
- Low power consumption and 1 - 400 kHz bandwidth.
- Built-in waveform processing and DMA & Bus Mastering transfer for high-speed transfer of waveforms on all 8 AE channels needed for advanced AE.
- Digital signal processing circuitry virtually eliminates drift, thereby achieving high accuracy and reliability.

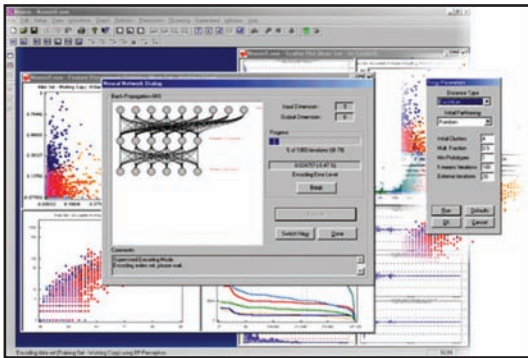


Figure 6. NOESIS™ software for pattern recognition and neural networks.

μSAMOS™ Software. . . Notebook Based, Portable Workstation for Advanced Acoustic Emission Testing

The μSAMOS (Sensor based Acoustic Multichannel Operation System) is a small, truly portable, battery (optional) and notebook operated, acoustic emission system. It is similar in size to a notebook computer, and contains up to three PCI-8 cards to form a powerful 8, 16 or 24 channel Acoustic Emission system.

- Compact size with high channel density (up to 24 channels),
- Portability and light weight (less than 10 lbs)
- Connect to a notebook computer while maintaining good AE acquisition performance and field ruggedness.
- External connector allows connection of up to 2 parametrics, control input and Alarm output functions

SAMOS™ Software. . . supported by PAC's AE multi-channel systems experience since the early 70's

- SAMOS™ Multi-channel AE Systems are supported by PAC's Windows platform of PACwin™ Suite.
- All software runs in Windows 2000 and XP, thus taking advantage of standard Windows features, such as multi-tasking, graphic user interfaces, printing, networking, etc.
- "Structure" based location setup, where the user selects the structure for visualization and sensor setup. Choices include Plate, Vessel, and Pipe for 2D Location and optional spherical 3D and Tank Bottom (see Figure 6 for a zonal attenuation map)
- Multiple location algorithms are available including linear, planar, tank bottom, cylindrical, conical, spherical (with ASME weld zones), anisotropic location for composites analysis, and 3D using advanced Non-Linear Regression (NLR) location, and over-determined planar location for exceptional accuracy.

Improved 2D Planar Source Location

AEwin™ location algorithms are based on Nonlinear Regression (NLR) schemes using Simplex search engines. To improve location, 3-8 hits within an event are used (Over-determined Method) versus just 3-hits for common location algorithms presently used in the AE industry. To further improve the AE accuracy, source-corrected amplitude features are calculated for each locatable event based on the user input attenuation curves and the source distance.

Spherical Location Option

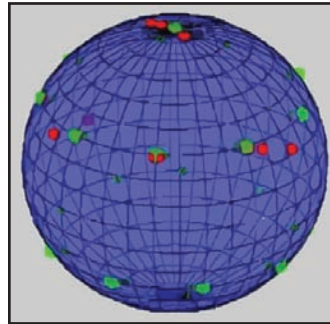


Figure 7. Spherical Location Option.

- Spherical Location using 3-8 hits per event versus 4-8 for old systems
- Avoids bad "linear events"
- User picks **any** starting view point
- Interactive pan, zoom and rotate, in real time
- Variable grid spacing or no grid
- Opaque or Transparent (100%), to view events in rear of sphere

- Data cursor for coordinates without the guess work
- Easy sensor, weld & nozzle placement per ASME code
- Pick sphere, sensor and data colors

3-Dimensional Location Option

- Utilizes 4-8 hits per event to determine location
- Avoids highly error prone "planar events"
- Adds planar event analysis for pencil lead breaks on any surface (XY, YZ & XZ)
- Sensors display on 2D views allowing easy set up of top, front and side views
- Interactive pan, zoom and rotate
- Multiple 3D graphs can be set up

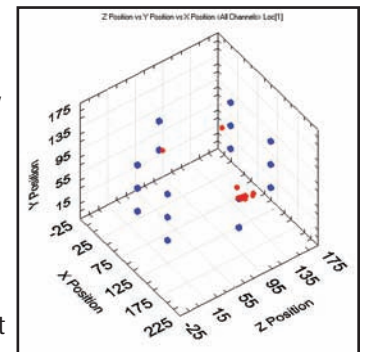


Figure 8. 3D Location Option

- Data cursor for exact coordinates
- User can set sensor and data point colors

Tank Bottom Location Option

- Locates, draws and in color
- User sets grading levels and colors
- Also lists result in tabular format. User picks table size and location variable
- Color by value or feature graphs
- 3D Tank Bottom location views

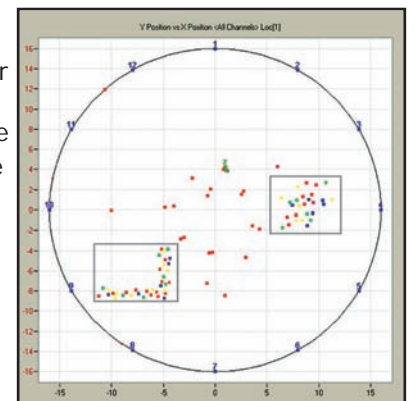


Figure 9. Tank Bottom Location Option

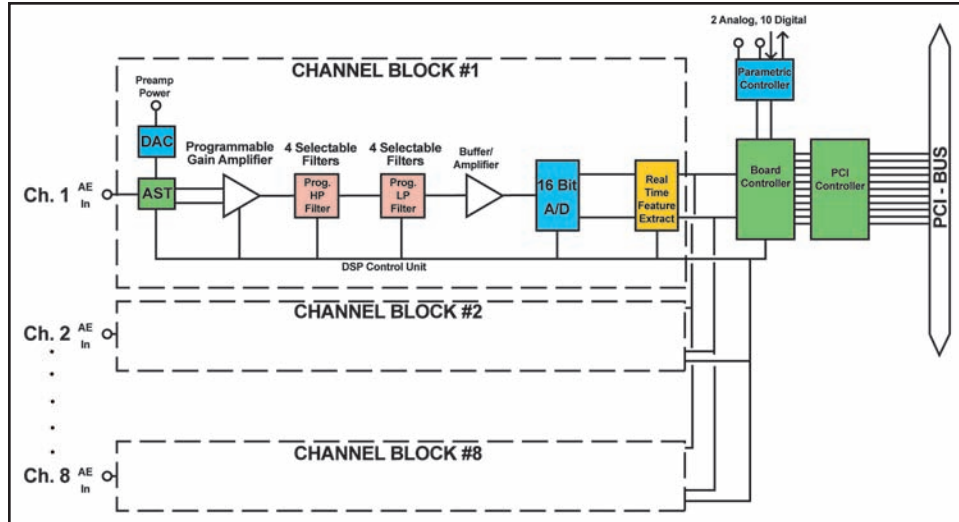


Figure 10. PCI-8 Block Diagram

PCI-8 Board Sample Specifications:

Physical Specifications:

- **Size:** 13.415" L x 4.8" H x 0.7" T
- **Weight:** 1.1 lbs.
- **Power Consumption:** 10 Watts (without sensors or preamps)
- **DC Power:** +12.0 volts, 0.4 amps
-12.0 volts, 0.1 amps
+5.0 volts, 1.0amp

Electrical Specifications:

- **AE Inputs:** 8 channels
- **Input Impedance:** 50 Ohms
- **Preamplifier Power:** 28V Phantom Power
- **Sensor Testing:** AST built-in
- **Frequency Response:** 1 kHz - 400 kHz (at -3 dB points)

Signal Processing:

- **AE Signal Gain:** 0, 6, 12 dB computer selectable
- **Filters:** 4 High Pass **computer selectable filters** - 1 kHz, 5.0 kHz, 20 kHz, 100 kHz, 4th order Butterworth
4 Low Pass computer selectable filters - 50 kHz, 100 kHz, 200 kHz, 400 kHz 4th order Butterworth
- **Max. Signal Amplitude:** Up to 100 dB AE; Up to 99 dB ASL
- **ADC Type:** **16 bit**, 3.0 MSPS per channel maximum
- **Waveform Sample Rate:** Computer selectable, 100 kSPS, 200kS/s, 500kS/s, 1M-Samples/second
100 kSPS, 200 kSPS, 500 kSPS, 1MSPS, 3MSPS

• Extracted AE Features:

Time of 1st Threshold Crossing, Time to Peak, Peak Amplitude, Signal Strength, Duration, Rise Time, Counts, Counts to Peak, True Energy, RMS, ASL, Parametric 1 & 2 and many real-time calculated features including, Average Frequency, Reverberation Frequency, Frequency Centroids, 4 Partial Power features and Peak Frequency

Analog Parametrics:

- **Parametric Channels:** 2 per board
- **Parametric A/D Res.:** 16 bits
- **Parametric Sample Rate:** 10 kHz sample rate for each analog parametric
- **Time Driven Data Rate:** Controlled by software
10 msec. to 60 seconds
- **Time Parametrics:** All parametrics are available in time data set

Additional I/O:

- **Digital I/O:** 8 Digital Inputs, 8 Digital Outputs
- **Audio Monitor Interface:** Analog switch and buffer to select desired channels to be routed to PAC audio monitor board or scope output
- **LED Activity Monitor:** On board LED driver to directly drive LED's on front panel. LED minimum on-time is 0.05 seconds



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