MISTRAS
A World of NDT Solutions
Products & Systems Division

PHYSICAL ACOUSTICS CORPORATION

DiSP™ Advanced DSP Workstation for Simultaneous Processing of Acoustic Emission Features and Waveforms

. . .The next step for SPARTAN™ Systems

The DiSP™ Concept. . . the next generation of multichannel parallel processing Acoustic Emission (AE) Systems for **simultaneous processing** of AE features & Waveforms. Built on the 15-plus years experience of the venerable SPARTAN™ Systems and the introduction in 1994 of the first 16-bit DSP based Digital AEDSP-32/16 MISTRAS-2001 System, this new Digital Signal Processing (**DiSP™**) AE Technology draws its power and performance from today's personal computers, PCI advantage and the PCI/DSP-4 AE Subsystem on a card.

PCI/DSP-4 AE Subsystem on a Card

The PCI/DSP-4 board is a 4-channel Digital Signal Processing DSP-based **AE data acquisition system** on a single, full-size, PCI-bus card. PCI/DSP-4 boards can be implemented inside most PC computers or inside one of PAC's rugged, PC-based industrial boxes to form multichannel **Digital Signal Processing (DiSP) workstation** Acoustic Emission Systems. Due to advances in surface mount technology and high density **DSP & ASIC** devices, we have been able to provide this single PCI card with 4 complete high-speed, channels of Digital Signal Processing (DSP) based AE data acquisition, up to **8 parametric input channels** (on the first card) and optional waveform module. Through the high performance PCI bus, significant AE data transfer speeds (up to 132 Megabytes/second) can be attained.

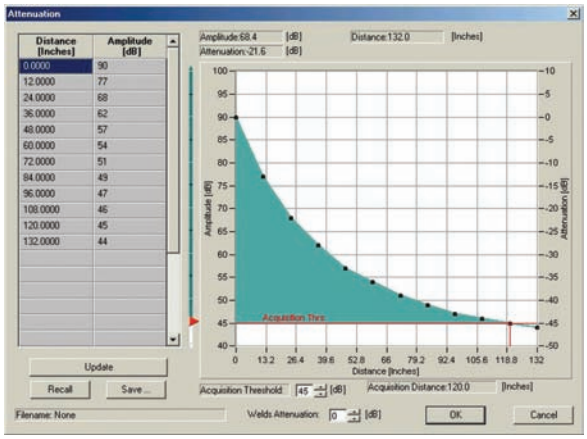

Figure 3. *Attenuation profiles can easily be constructed in AEwin™ Software and displayed in tabular and graphical form. Attenuation maps of the structure are generated in AEwin™ and show sensor coverage. Location software uses these profiles to also report source amplitude.*

Figure 1: *4-Channel AE System on a PCI Card.*

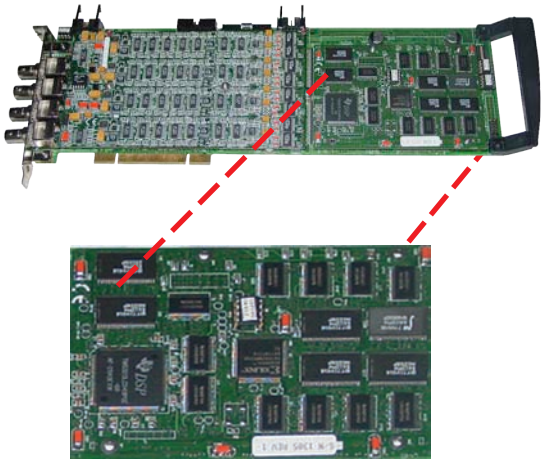

Figure 2: *Optional DSP based waveform module.*

. . .Make Your Own Customized AE System

Utilize PCI/DSP-4 Subsystems and your own PCs to build customized AE Systems. PAC will provide you with Windows DLLs, LabView drivers, etc. Please contact us for more details.

DiSP AE Workstations

Each **DiSP Workstation** houses an entire AE system on a powerful, integral PC computer with CD-RW, hard and floppy disks, and the standard complement of parallel printer port, serial port, USB, LAN and mouse port, as well as up to 56 AE channels. Several different chassis are available, including

Applications:

- On-line asset management, such as bridges, power plants, offshore platforms, transformers
- Pressure vessel testing, including spheres
- Above ground storage tanks
- Petrochemical and gas pipelines
- Tube trailers and high pressure gas cylinders
- Industrial field testing with AE
- Advanced materials and corrosion testing
- Nuclear components (valves, lift beams, steam lines)
- Composites and Aerospace components & structures
- FRP (GRP) vessels and rocket motor cases
- Weld monitoring (real or post-time testing)
- Reactor and High Energy Piping (HEP) testing in power

sizes for 8, 16, 24 and 56 channels. Built-in AE features include a digitally controlled high fidelity AE audio monitor (standard on DiSP-24 and DiSP-56 System), 8 parametrics and AE Hit indicator LEDs. System communication capabilities include built-in Ethernet 10/100 LAN and optional AE system expansion interface for connecting multiple DiSP Systems to one AE test. The optional "PAC AE System Viewer" software provides the ability for remote control over your company network or the Internet.

Figure 4: The DiSP-16BT is designed for laboratory & light industrial applications.

DiSP-16BT

The **DiSP-16BT** AE **Controller** is based on a high-performance PC, designed for both laboratory and light industrial use. It houses up to four (4) 4-channel AE subsystem PCI cards (PCI/DSP-4), for a total of 16 channels of **simultaneous** feature/waveform based AE. DiSP-16BT is 17" (43 cm) W, 17" (43 cm) D and 6" (15.2 cm) H and weighs 26 lbs. (with 16 channels). It has a heavy-duty desktop PC computer chassis with added features for reliable day-to-day operation, including extra cooling and ventilation. The PC Main AE controller gives the user the lowest cost for a high-performance AE system.

DiSP-24

Similarly, the **DiSP-24** is a **portable, hardened and compact** AE system, equipped with a handle for carrying and an integral keyboard built within the hinged front protective cover. Weighing less than 38 lbs. (17.3 kg) with all 24 channels, the DiSP-24 is 21" (533 mm) L x 14" (356 mm) W x 7.6" (193 mm) H.

Figure 5: Compact, portable, 24-channel DiSP-24 AE Workstation.

DiSP-56

The **DiSP-56** AE Workstation houses up to 56 (14 PCI/DSP-4 AE subsystem boards) simultaneous feature/waveform based AE channels along with 56 Hit LED's on the front panel. It has a heavy-duty, industrial, desktop (or rack mountable) chassis with high capacity cooling and ventilation for reliable day-to-day operation. The DiSP-56 is 17.5" (445 mm) W, 10.5" (267 mm) H and 19.0" (483 mm) D and weighs 58 lbs. (26.5 kg) with 56 channels. The system is expandable to several chassis with LAN technology.

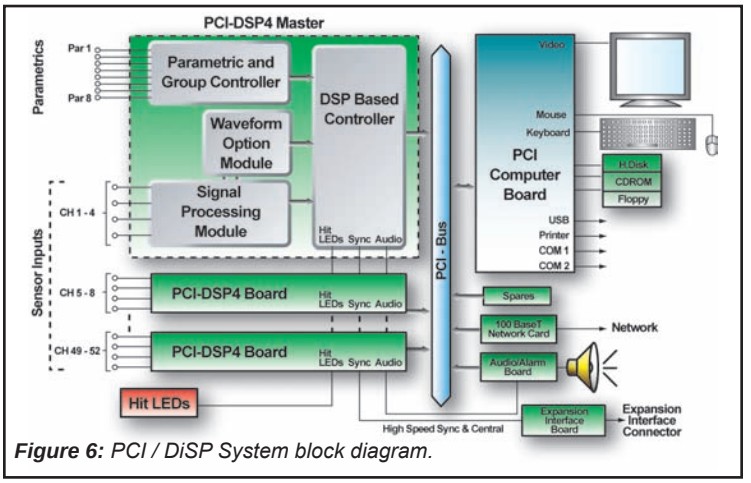

Figure 6: PCI / DiSP System block diagram.

µDiSP

The µDiSP (microDiSP) is a small, truly portable, battery (optional) and notebook operated, acoustic emission system. It is similar in size to a notebook computer, containing one or two PCI/DSP-4 cards to form a powerful 4 or 8 channel, simultaneous processing of acoustic emission features and waveforms, DiSP based system. Key advantages of the µDiSP over conventional AE system chassis include its small size yet high channel density (up to 8 channels), its portable and light weight (less than 10 lbs) design, its connectivity to a notebook computer, all while maintaining very good AE acquisition performance and field ruggedness. An external connector allows connection of up to 8 parametrics, control input and Alarm output functions.

Figure 7: The heavy-duty DiSP-56 Workstation.

Figure 8: The µDiSP Portable AE System.

Key Features . . . *include*

- Advanced parallel processing DSP Acoustic Emission technology with high-speed PCI cards
- Proven knowledge-based AEwin™ software and state-of-the-art LAN networking capabilities
- Four, low noise, 16-bit, high-speed A/D converters
- High-performance, multiple DSP technology on a single 4-channel PCI/DSP-4 card
- Multiple FPGA's for fast, simultaneous AE parallel processing of AE features and waveforms
- Up to 8 parametrics on the first PCI/DSP-4 card
- Progressive real-time AE features in both time and frequency domains
- Multiple software programmable filters

User Friendly. . . by Design

- **Front Panel** activity lights are totally under the control of your PC to provide status on AE data as well as to give you indication of any malfunctioning of your system.
- All digital, full-featured **Audio Monitor** built in and ready for "high fidelity" listening *(optional)*.
- **Auto Sensor** testing standard with all PAC systems for easy system/sensor self calibration and interface coupling efficiency of **sensors to the structure**.
- Software available for the DiSP™ includes the state-of-the-art **PACwin™ Software Suite.** With 30 years of Acoustic Emission application experience behind it, this Suite is comprised of three individual software packages *(purchased separately)*; these are: **AEwin™** real-time Windows acquisition, replay and analysis software, **AEwinPost™** post analysis software and **NOESIS™**, the most complete pattern recognition (supervised or unsupervised) and neural networks software in the AE and NDT market today. *(Ask about our free software drivers for reading competitive system data files, so that their AE data makes sense.)*

System Flexibility. . . by Design

Standard 32-bit PCI hardware and 32-bit Windows AEwin™ software allow the customer maximum flexibility of using a PC or 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 chassis are easily synchronized for multiple location algorithms.

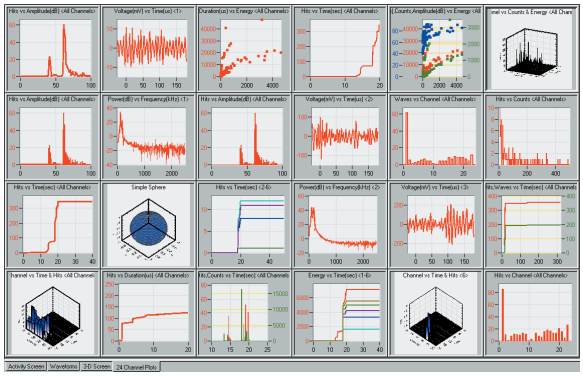

Figure 9. *Many graphs per screen can be viewed in real time or replay. This screen shows some of the flexibility of AEwin™. In this overview, 2D and 3D graphs, waveforms, FFT's, line graphs, histograms, multi-plot graphs, etc. are shown* ***in real time****.*

Typical DiSP™ 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 full Windows resources including printing, network, multi-tasking, and more
- Play your existing DTA files from previous systems
- Multiple graph types include 2D, 3D (fully rotatable), line point plots, histograms, multiple plots within a graph, waveforms, FFT's, and more
- Arrange multiple graphs on a screen (as many as you like)

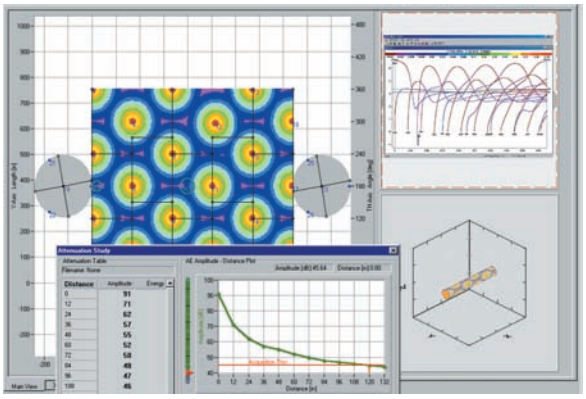

Figure 10: *Advanced AE sensor coverage based on dispersion curves with attenuation entry table and plot for accurate location (based on Lamb waves).*

- Zooming, panning, cursor readout
- Multiple location modes (Zonal, Linear, Planar, 3D-LOC)
- Structure based, geometry smart location modes including vessels, cones, spheres and 3D, all with 2D and 3D displays
- Hit and Event linking to other graphs

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

DiSP Systems are supported by PACwin™ Software Suite, a PAC Windows Platform consisting of AEwin™, AEwinPost™ and NOESIS™ *(individually purchased)*. All software runs in Windows 98, ME (Millennium Edition), 2000 and XP, thus taking advantage of standard features such as multi-tasking, graphic user interfaces, etc. and providing the ability to change AE parameters during test operation.

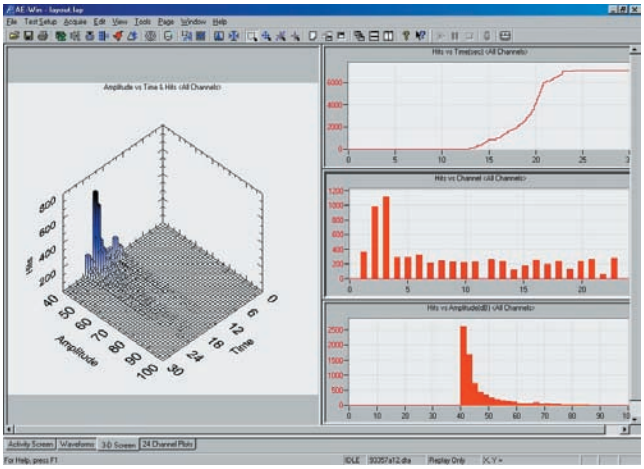

Figure 11: *AEwin's 3-D graphing capability allows the graph to be rotated freely using the mouse.*

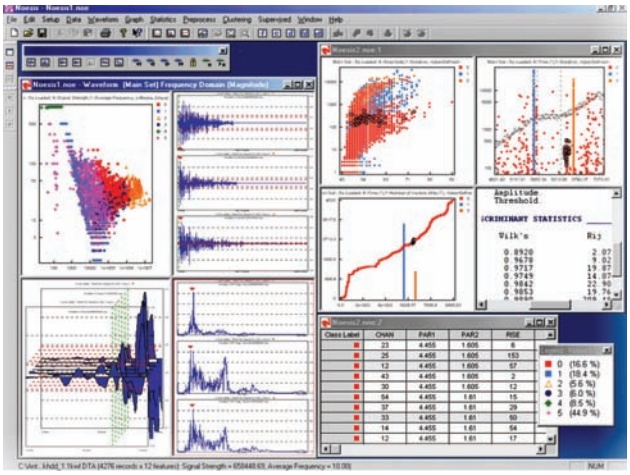

Figure 12. *NOESIS™ Software for the DiSP is sophisticated, yet user friendly and operates under all Windows platforms.*

Multiple location algorithms are available including linear, planar, tank bottom, cylindrical, spherical (with ASME weld zones), 3-D, advanced Non-Linear Regression (NLR) location, and over-determined planar location for exceptional accuracy. All location algorithms utilize attenuation tables/curves, auto-sensor placement, and source corrected amplitude for more accurate location and AE intensity calculation.

PCI/DSP-4 Specifications:

Physical Specifications:

- **Size:** 12.28" L x 4.2" H x 0.6" T
- **Weight:** 1.1 lbs.
- **Power Consumption:** 15 watts
- **DC Power:** +12.0 volts 0.6 amps; -12.0 volts 0.1 amps; +5.0 volts 2.0 amps (1 amp can be from +3.3V)

Interface to PC: Through PCI (Peripheral Component Interconnect Bus)

Electrical Specifications:

- **AE Inputs:** 4 channels
- **Input Impedance:** 50 ohms
- **Sensor Testing:** AST
- **Frequency Response:** 10 kHz - 2.1 MHz ± 1.0 dB

SPM Module: ***(Attaches to PCI/DSP-4 Main Board)***

- **Dimensions:** 3.5"x 6.5" module with filters & ADC's
- **Filters:** 4 High Pass - software selectable 10kHz, 20 kHz, 100 kHz, 200 kHz, 4 Low Pass - software selectable 100kHz, 200 kHz, 400 kHz, 2.1 MHz
- **Noise Minimum Threshold:** 18 dB AE
- **Maximum Signal Amplitude:** 100 dB AE
- **ADC Type:** 16 bit, 10 MSPS per channel
- **Dynamic Range:** > 82 dB
- **Sample Rate:** Fixed @ 10 MSPS (for features)

Processor: TMS320C33 - 32 bit Floating Point DSP

- **Speed:** 75 MHz, 150 MFLOPS
- **Standard On-board Memory:** 1 Mbyte

Waveform Option Module: 4-channel plug-in module

- **Processor:** On-board DSP Processor
- **DSP & Waveform Buffer:** 1 Mbyte
- **Waveform Memory:** 128 kbytes/channel standard
- **Sample Length:** Variable from 1 to 15 ksamples per channel
- **Waveform Sample Rate:** Selectable 10 MSPS, 5 MSPS, 2.5 MSPS, 1 MSPS, 500 KSPS, 200 KSPS, 100 KSPS

Parametrics: All parametrics are located on the first board

- **Parametric Channels:** 8 channels std on Master PCI/DSP-4 (1st board), ± 10 volt input, 16-bit A/D
- **Parametric Input Type:** Differential on channels 1-2, single ended on 3-8
- **Parametric Sample Rate:** 20 kHz sample rate for each analog parametric
- **Hit Driven Parametrics:** 2 - analog hit parametrics, serial bus transmit parametrics to all PCI/DSP-4 boards in all chassis at parametric sample rate
- **Time Parametrics:** All 8 parametrics are available in time data set
- **Time Driven Data Rate:** 10 msec. to 60 seconds, controlled by software
- **Parametric Time Gate:** AE data acquisition inhibited parametric value. Two Thresholds. Flexible gating options - outside thresholds, inside thresholds, positive/negative slope
- **Cycle Counter Type:** 24 bit count resolution. Software programmable threshold from 0 - 5.00 volts in 10 mv steps. Independent software selectable source - analog parametric channel 1-4 (filtered or unfiltered). Serial bus transmits cycle counter to all PCI/DSP-4s, in all chassis

Audio Monitor: Software controllable analog switches and buffer to select desired channels to be routed to audio monitor board

LED Activity Monitor: On-board Hit LED drivers, directly connect to LEDs on front panel

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