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USB-AE Node™ & AEwin™ for USB™ Software

User's Manual

Rev 0

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Part #: 1283-1000

Associated with: AEwin for USB™ Software
Part # : 1283-7001
Version E3.32 or Higher

USB-AE Node™ & AEwin for USB™ Software User's Manual
Rev 0

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PREFACE

Introduction to USB-AE Node and AEwin-Lite

Thank you for your purchase of the USB-AE system, and AEwin-Lite (or AEwin for USB) software. The combination of the Physical Acoustics/MISTRAS, USB-AE node(s) along with AEwin-Lite makes a truly powerful, full featured AE system, with all the capabilities of our highest performance, multiple channel, AE systems such as DiSP, PCI-2, PCI-8/SAMOS and Sensor Highway at a very attractive price, making Acoustic Emission available to all, even those with the smallest of budgets. In addition, the user can start off with one channel and can expand it to additional channels and slowly build up a complete AE multichannel instrument for the laboratory. The purpose of this document is to help you understand the difference between the full version of AEwin and AEwin-Lite. This section will also duplicate information about installing the USB-AE Node to your PC compatible computer or notebook computer.

The differences between the full AEwin version and AEwin-Lite is simply that AEwin comes with zonal and linear location modes built-in, while they are options in AEwin-Lite. Additionally, waveform processing is an option in AEwin-Lite. In addition, all options available in AEwin are also available in AEwin-Lite as options also. Therefore there are no compromises in AEwin-Lite, all the capabilities are available. This includes options such as 1, 2, 3 and 4 channel operation, full 2D, Planar location, 3D Location, AEwin Post analysis, Supervisor Mode, On-Line Leak and Crack Alarms, and much more. So your system can grow as your needs require. Please feel free to contact the factory regarding any questions about options of AEwin or AEwin-Lite.

Since there are virtually no differences between AEwin and AEwin-Lite, we are providing the full AEwin manual and just want to point out that where the manual indicates that the Zonal and Linear Location modes are standard, that in AEwin-Lite, these features are not present unless the full location option has been ordered. Also, note that any information about waveform acquisition and processing is not available in AEwin-Lite unless the option was purchased. Other than that, all features listed in the AEwin manual (the remaining part of this manual) are included and available in AEwin-Lite software.

As with any USB device, your USB-AE node needs to be installed into your computer before it can be utilized as an AE system. There is a two step process involved. The first step is to install the USB-AE Node into the computer and the second step is installing and licensing AEwin-Lite into your computer. This will be covered in other sections of this manual.

We thank you for your purchase of the USB-AE Node and your interest in the Acoustic Emission technology.

USB-AE NODE™ & AEWIN FOR USB™ SOFTWARE USER'S MANUAL

1. ABOUT THIS MANUAL

Thank you for your purchase of the USB-AE Node system. We are sure that you will be very happy with the power, performance, portability, ease of use, rich graphing capabilities, and the fact that the USB-AE Node system is a true, full featured AE system complete with waveform and FFT processing as well as the traditional AE feature extraction with all the same AE features as you would find in one of our PCI based AE systems.

The purpose of this manual is to be a guide to help you install the USB-AE Node on a computer, and to help you understand all the capabilities of the system and how to use it. Due to the fact that this is a portable system, the goal of this manual is to be short and concise. Due to these goals, we are providing you with this guide (not manual), with the intentions of keeping the manual compact, we have decided to forego some standard sections which we normally supply in our full manuals and we have made some assumptions regarding the content that needs to be in this manual. The assumptions we have made in preparing this manual is that the user is already proficient in the technology of Acoustic Emission and therefore we do not need to include AE training type materials. We have also assumed that the user is familiar with the MISTRAS-Physical Acoustics Corporation, AE systems and also knowledgeable in the use of our premium AE software, AEwin. This allows us to use this manual to explain the software menu layout and how to use the software, rather then define each software menu. In addition to these assumptions, we have also left out reference materials such as appendices regarding detailed file structures of the software and AE application documents. The end result is that we have provided a user guide which comes to the point and can be used as a handy reference in using your new USB-AE Node system.

If you require extra information, please visit us at our website at www.mistrasgroup.com. Should you have any questions, concerns or comments please feel free to contact our Customer Service department at customer.service@mistrasgroup.com or our Sales department at sales.systems@mistrasgroup.com.

We have included our "System Defect Report and Product Enhancement Form" on the last page of this manual for your convenience.

2. OVERVIEW OF THE USB-AE NODE SYSTEM

The USB-AE Node system is a "true" high performance, computerized Acoustic Emission (AE) system packaged in a small anodized aluminum case. Once linked with a PC running "AEwin for USB" software, the USB-AE Node system has all the performance features of a larger, more expensive AE system including AE bandwidth, speed, AE features, sampling rates and waveform processing capabilities, all in a compact packaging. The USB-AE Node system is capable of performing any AE application which on of our larger AE systems can and is an excellent field survey tool, especially in situations where plug-in power is not readily available but a notebook or netbook PC computer is. But mainly, the USB-AE Node best suited for use in the laboratory and capable of carrying out lab tests, utilizing its 1 channel AE capability and 4 channel parametric inputs for correlating load or stress with AE activity. In addition, source location and spatial filtering options are available when 2 or more USB-

Figure 1. USB-AE Node Unit

AE nodes are connected up to a single PC (See Getting Familiar with the USB-AE Node System interfaces for more information).

The USB-AE Node system performs traditional AE feature extraction based, AE signal processing as well as advanced waveform based acquisition and processing. Data and waveforms may be recorded and read back just as they are on any other MISTRAS-PAC system running AEwin.

The USB-AE Node system processes one channel of AE with its internal 18 bit A/D conversion, up to 20 MSamples/second and 1.0 MHz signal bandwidth. In addition the USB-AE Node has analog and digital Inputs and Outputs (I/O) including Four (4), 16 bit parametric sensor input channels to monitor "cause and effect" relationships between AE and load. There is also one channel of programmable Digital Input/Output available, as well as two channels of Analog Output, each with a 0-4.5V output range.

Some of the key features of the USB-AE Node system include the following:

- One channel AE instrument with all the standard performance features as in PAC's standard, multi-channel AE instruments.
- Small portable unit for quick, efficient testing in the field or laboratory. Less than 1 minute setup.
- Full-Speed USB 2.0 Interface to ensure compatibility with any modern PC or Laptop running Windows XP or newer.
- Full AE bandwidth response – 1.0 kHz to 1.0 MHz
- Up to 4 USB-AE Node systems may be connected to one PC and linked together with available Time-sync cables, allowing support for optional source location modes.
- Runs directly off of PC's power, so there is no need for internal battery packs or external power supplies.
- Uses PAC standard low cost passive AE sensors or our new "PK" line of low power, integral preamplifier sensors.
- A high performance, high speed, 18 bit A/D is used on each USB-AE Node, with up to 20Mega-Samples-per second sampling rate.
- Using an 18 bit A/D for AE signal processing provides wide system dynamic range without the need for gain controls.
- Four, 16 bit A/D parametric sensor inputs for correlating AE to other process sensors.
- LED display to quickly update the user on Power/Hit/Alarm status.
- Permanent digital record of the test results in standard PAC, DTA data files, compatible with AEwin for detailed data analysis and data visualization.

2.1 AEwin for USB Software Overview

The USB-AE Node comes with a complete working AE program to perform a variety of AE tests. The program is configured just as any other Microsoft Windows program with a typical menu structure with the familiar menu selections such as "File", "Setup", "Acquire/Replay" and "Help". The user is able to configure the unit in preparation for an AE examination. The user is able to set up multiple graphs for viewing on multiple tabs. Included in the software is the ability to view waveforms, FFT's, histograms, line graphs and point plots and the traditional anything versus anything style (see some of the example graphs). During acquisition or replay the graphs can be manipulated to allow the user to view pertinent data on the fly. Data is saved in a standard PAC defined DTA file for use with AEwin Replay, AEwinPOST and other PAC analysis programs such as NOESIS.

2.2 Sensors for USB-AE Node products

The USB-AE Node products have a built-in, internal AE preamplifier and also have the capability for powering our line of low-power external preamplifiers and our PK series, Integral Preamplifier sensors. The user can select between the use of the internal and external preamplifier via a set of jumper's inside the enclosure. When in Internal preamplifier mode, standard, passive (non-amplified) sensors (such as our Alpha sensor family) can be attached directly to the AE inputs of the USB-AE Node system. The R15a (the "a" stands for Alpha series of sensors) sensor is the most common AE sensor used in most applications. The sensor cable for connecting the sensors to the system is the 1282-4003-L, where L denotes length in meters. Our line of Alpha sensors are our low cost, general purpose sensors and come in many frequency ranges for any application including R3a, R6a, R12a, R30a, R50a, and WSa. These sensors are single ended, high sensitivity sensors and are directly compatible with the USB-AE Node system.

Additionally, the USB-AE Node products can be switched (via hardware jumpers located on the board) to external Preamplifier mode. When in this mode a low voltage phantom power is supplied on the center conductor of the AE input connector to provide power to the external preamplifier. This is the typical phantom power arrangement which provides power to the external preamplifier, the amplified AE signal back to the AE system, and AST. Examples of sensors meant for this application include the PK3I, PK6I, PK15I, and PK30I integral preamplifier sensors.

More information can be found in section 4.1.2, Optional and Spare Part for your USB-AE Node system.

2.3 Applications

The USB-AE Node is capable of performing any AE test where one to four channels of Acoustic Emission monitoring is required. The USB-AE Node is ideal for laboratory testing or in the field in applications such as leak detection, AE characterization of materials and processes, and screening tests in remote areas, to determine if further action needs to be taken using a larger AE system. In addition with its built-in parametric processing circuitry, AE can be correlated with other sensors and process stresses.

3. GETTING STARTED

The purpose of this chapter is to help the user become familiar with the USB-AE Node system and get the user to a point where he can turn on the unit and get it running in his application.

3.1 Unpacking and Inventory Check

Figure 2 shows a picture of the key basic components of a single channel USB-AE Node system. The user should remove and verify the contents of what has been provided and that there is no damage either to the USB-AE Node case itself or any of the other components that have been shipped with the unit. Make sure there is no visible damage to the unit itself. DO NOT PROCEED WITH THE INSTALLATION IF YOU ARE UNSURE ABOUT ITS CONDITION. If there are any questions at all regarding shipment damage, please call Physical Acoustics Customer Service Department immediately.

Carefully check the delivered parts against your purchase order, our packlist form and the list of standard components below. Note any back ordered items. In the event of any discrepancy please notify Physical Acoustics' Customer Service department at customerservice@pacndt.com.

3.1.1 Standard Components in a USB-AE Node system

- The USB-AE Node unit itself
- 1 qty, USB Mini A/B cable, part number W080-0400.
- 1 qty, paper or CD copy of this manual, part number 1283-1000.
- 1 qty, CD copy of AEwin for USB software, part number 1283-7001.

Figure 2. USB-AE Node and Accessories
*Sensor and Sensor Cable Not included as a standard component, these are order dependent.

3.1.2 Optional and Spare Parts for your USB-AE Node system

There are many spare parts and optional parts available for your USB-AE Node system. The list below describes these items. Please call our Sales department at 609-716-4000 or email at sales@pacndt.com if there are any questions or interest in these items.

AE Sensors (Passive): Physical Acoustics has a large selection of AE sensors that can be used with your USB-AE Node system. These include passive, non powered AE sensors and powered, Integral Preamplifier sensors. For the passive line of sensors, any single-ended, passive sensor in the PAC sensor family could be used with the USB-AE Node system. Passive AE sensors are used in situations where the sensor is within 2 meters of the USB-AE Node system. PAC recommends the Alpha family of low cost, general purpose sensors. These come in various frequencies as shown in the table below. Please contact the sensors part of our web page www.pacndt.com for more information or discuss with our sales department.

Sensor #	Alpha series Passive AE Sensor Description
R3a	Sensor, Alpha, 30kHz, Alpha, with SMB connector.
R6a	Sensor, Alpha, 60kHz, Alpha, with SMB connector.
R15a	Sensor, Alpha, 150kHz, Alpha, with SMB connector.
R30a	Sensor, Alpha, 300kHz, Alpha, with SMB connector.
R50a	Sensor, Alpha, 500kHz, Alpha, with SMB connector.
R80a	Sensor, Alpha, 800kHz, Alpha, with SMB connector.
WSa	Sensor, Wideband, (100 - 1000kHz), Alpha., with SMB connector.

Table 1. Alpha Series, Passive AE sensors for use with USB-AE Node system

Integral Preamplifier Sensors for USB-AE Node: For Integral Preamplifier sensors, PAC has a new family of low power Integral Preamplifier sensors made exclusively for the USB-AE Node system. These are our PK-XXI family of sensors (where the PK stands for Pocket). These sensors are smaller and more compact than our standard line of Integral Preamplifier sensors and have been developed to maintain a long battery life in the USB-AE Node system while at the same time offering a good low-noise performance, and long cable drive distances of at least 100 meters. In addition, these preamplifiers support the AST (Auto Sensor Test) function. A table of available PK series sensors is shown below. Please contact the sensors part of our web page www.pacndt.com for more information or discuss with our sales department.

Sensor #	AE Integral Preamplifier Sensor Description
PK-3I	Sensor, 30 kHz with Integral Preamp
PK-6I	Sensor, 60 kHz with Integral Preamp.
PK-15I	Sensor, 150 kHz with Integral Preamp.
PK-30I	Sensor, 300 kHz with Integral Preamp
PK-WI	Sensor, wideband (100 – 1000 kHz) with Integral Preamp.

Table 2. PK Series, Integral Preamplifier AE sensors with AST for use with USB-AE Node system

In-Line, Low Power Preamplifiers for USB-AE Node: To round out the product line and to provide for all possible applications for the USB-AE Node, a line of small, low power, single ended and differential preamplifiers has been developed for use with the USB-AE Node system. The key reasons for developing these preamplifiers is for low power consumption to maximize battery life of the USB-AE Node system. Other advantages include the small size (approximately 1" x 1" x 2" long or 25mm x 25mm x 50mm long), low cost and ability to use single ended or differential sensors. In addition, these preamplifiers support the AST (Auto Sensor Test) function. These preamplifiers are ideal when the user needs to use differential sensors and also higher temperature sensors and needs for the sensor to be some distance away from the USB-AE Node system.

Preamp #	In-Line, Low Power, Preamplifier Description
IL-LP-3X	In-Line, Low-Power, 30 kHz Center Frequency Preamplifier
IL-LP-3X	In-Line, Low-Power, 60 kHz Center Frequency Preamplifier
IL-LP-3X	In-Line, Low-Power, 150 kHz Center Frequency Preamplifier
IL-LP-3X	In-Line, Low-Power, 300 kHz Center Frequency Preamplifier
IL-LP-WX	In-Line, Low-Power, 100 – 1000 kHz Preamplifier
X = S or D	X: S = Single Ended D = Differential

Table 3. In-Line, Low Power (IL-LP) Series, Preamplifier with AST for use with USB-AE Node system

Sensor Cable: Two types of SMA-SMB cables are available for this product. For interfacing to Alpha series sensors we recommend part number 1502-4003-1 for a 1 meter cable or 1502-4003-2 for a 2 meter cable. This is a light duty cable most useful for short runs or for lab environments. For PK or IL series products, we recommend part number 1282-4003-1 for a 1 meter cable, 1282-4003-2 for a 2 meter cable, etc. This is a heavy-duty RG-58 cable most suited for harsher environments or longer cable runs. Custom cable lengths are available to fit your specific application.

Parametric Cable: Cable part number 1502-4002-2 is a 2 meter interface cable to parametric channel 1. The cable terminates in a standard BNC connector for ease of integration with your parametric signal. For different cable lengths change the last digit of the part number to match your required length in meters (e.g. to change to a 3 meter cable the part number becomes 1502-4002-3).

Parametric/IO Connector: Use part number 1283-5025 to order a parametric connector kit. This kit includes a DB-9 plug with solder cups on the back for a customer customizable interface to the Parametric and I/O signal lines. Also included is a DB-9 hood with cable strain relief to help prevent damage to the connector/cable assembly. This add-on is recommended for users with electronics and soldering experience.

USB Time-Sync Cable: Part number W080-5000. This cable links USB-AE Nodes together to obtain time synchronization for source location operation. If the user has multiple USB-AE nodes, they will need to daisy-chain these cables together. One cable is needed to link two (2), USB-AE Nodes together, two are needed to link three (3), USB-AE Nodes, three are needed to link four (4), USB-AE Nodes together. There is an "In" and "Out" connector on each USB-AE Node for connecting up the time synchronization.

USB Hub: Part number E400-0050. This optional Hub is available to allow the customer to expand their AE system beyond the limited number of USB ports available on their PC or notebook. This USB Hub has been thoroughly tested to work with our USB-AE Node systems and the use of any other Hub cannot be guaranteed to work.

Spare USB Cable: USB cables can get lost, forgotten or damaged. Replacement cables can be ordered using part number W080-0400.

Application Software Programs: Please stay tuned on the internet for other specific application programs for your USB-AE Node system.

3.2 Getting Familiar with the USB-AE Node System interfaces

This section introduces and describes the USB-AE Node connectors and the front panel LED tower.

3.2.1 AE Front Panel Connector Plate Description

Figure 3 shows a sketch of the USB-AE Node front connector plate. The front panel houses connections to your sensors. The "AE Sensor" connector is a standard SMB connector to interface to compatible AE sensors via our SMB-to-SMA cable. Additionally there is a DB-9 connector to interface to the 4 parametric channels and to the I/O ports. We have provided a separate SMB plug interface to parametric channel 1 (called "PAR 1) to allow quick connects/disconnects when only one parametric channel is needed. Regarding the connector descriptions, they include the following:

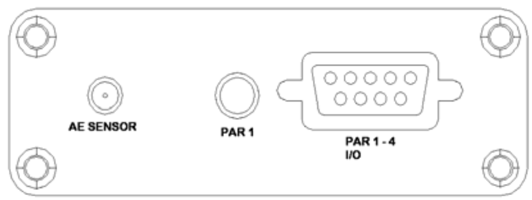

Figure 3. USB-AE Node Front

AE Sensor Connector: This is the AE input to the USB-AE Node system. The AE sensor plugs directly into this connector using an SMB cable connector. As was explained at the end of Chapter 1, the USB-AE Node system can be configured for using Passive AE sensors (which are standard) or via an on-board jumper setting, Phantom power can be provided for powering up a line of low power preamplifiers and Integral Preamp sensors.

Parametric and I/O Connector: The Parametric connector is a DB-9 Female type. One pin is designated as ground, while the others can be used in various ways to meet various applications. Figure 4 shows the pinout details of this connector.

Channels 1 through 4 are your parametric inputs – Channel 1 has an input range of -10 to +10V, while Channels 2 through 4 have an input range of 0 to +10V. All of these inputs are sampled by a high accuracy 16-bit, 100ksps A/D converter. Channels 5 through 8 are your user controllable I/O's.

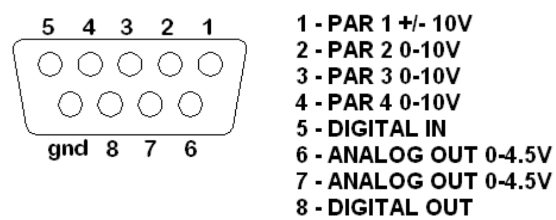

Figure 4. Description of DB-9-F Pinout – Viewed from Front

Channel 5 is a digital input – any input less than 0.5V is logic 0, any input greater than 2V is logic 1. Input voltages are tolerated up to +7 Vdc.

Channel 6 and 7 are your two analog outputs. These outputs are software controllable and can output a signal anywhere between 0 V and 4.5 V. These outputs are generated by a high accuracy 16-bit DAC and individually buffered.

Channel 8 is a digital output. This output is a software programmable binary signal with logic 0 at 0V and logic 1 at 3.0V. This output is buffered.

Parametric 1 Connector: There is an additional parallel interface to parametric 1 available via a standard SMB plug connector. This allows for quick connects/disconnects of a single-ended parametric input. There is a 2 meter long parametric cable available (PAC p/n 1502-4002-2) to allow the user to connect to an external single ended voltage source from a load cell, temperature, pressure or other type signal which the user wants to process along with the AE signal. Connecting to this port is the same as connecting to pin 1 on the DB-9 connector – please be careful to avoid using both connectors to apply two separate signals to parametric input 1 at the same time.

3.2.2 Rear Panel Connector Plate Description

Figure 5 shows the USB-AE Node rear connector panel. This is the panel that houses the USB interface connector, the Time Synchronization connectors and the LED status indicators. Each of these are described further below.

USB Mini A/B Connector: This is the USB-AE Node's interface to the PC. Power is supplied over this connection via your computer's 5V, USB line, and data is transmitted back and forth between your computer and the USB-AE Node's processor. Data is transmitted at the full 12Mbps USB 2.0 speed.

Link In/Link Out Connectors: These connectors are provided to give the user the option of daisy-chaining up to 4 USB-AE Node systems together on one computer for time synchronization which is needed for source location option. THESE CONNECTORS ARE NOT TO BE USED AS AN ETHERNET CONNECTION. One USB-AE Node must be selected as a master. This Node will control the timing of all other USB-AE Nodes connected on the chain.

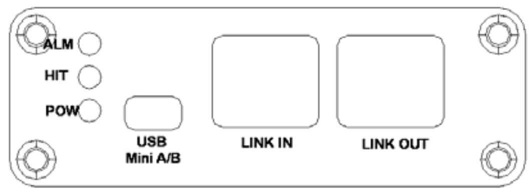

Figure 5. USB-AE Node Rear

LED Status Indicators: LED indicators are supplied to let the user know the status of the system at a glance.

The Green POWER LED (lower LED, "POW") will remain lit as long as the USB-AE Node is powered and operational.

The Yellow "HIT" LED will light whenever an AE hit is detected by the USB-AE Node.

The Red ALARM LED is user programmable and will warn the user when a predetermined event has occurred. This event is user configurable. Typically an alarm situation is defined to be an AE hit whose characteristics exceed the ordinary, such as a too long a duration or a too-high amplitude.

3.3 Typical Setup Configurations for the USB-AE Node System

The sections below show the setup and connection diagrams for various USB-AE Node configurations including a single channel USB-AE Node using our Alpha series passive AE sensors, setup for a single channel USB-AE Node using our PK Series Integral Preamplifier sensors, a setup diagram for a multi-channel USB-AE configuration. This will help you set up your system and get it all connected up and ready for operation.

3.3.1 Configuration for use with Alpha (Passive) sensors

A typical configuration for a single channel system is shown in figure 6 below. By default your system will arrive configured to work with passive AE sensors. Cable number 1502-4003-X provides an interface between the sensor and the USB-AE Node. Cable number W080-0400 is a standard USB cable to connect your USB Node to your computer. As can be seen, this is a very simple connection.

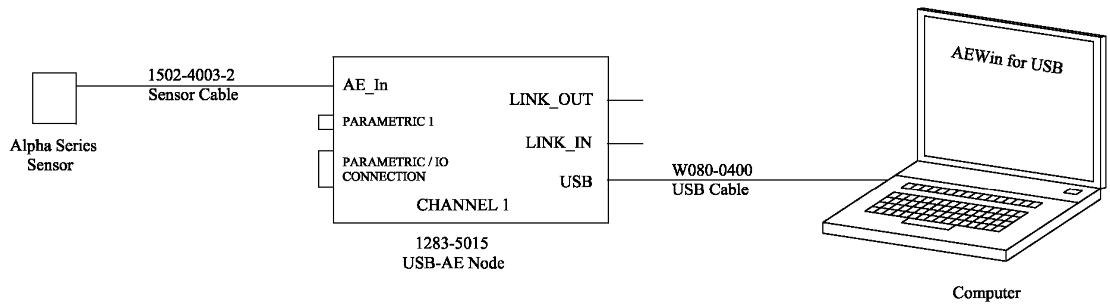

Figure 6. One Channel Passive System

3.3.2 Configuration for use with PK (Integral Preamp) sensors or IL (In-Line) Preamps

A typical configuration for a single channel system with a PK, Integral Preamp AE sensor is shown in figure 7 below. Please note the change in cable for use with this type of sensor. Cable 1282-4003-X is of a heavier duty than the 1502-4003-X and as such is better suited for long cable runs or in environments where rough handling likely.

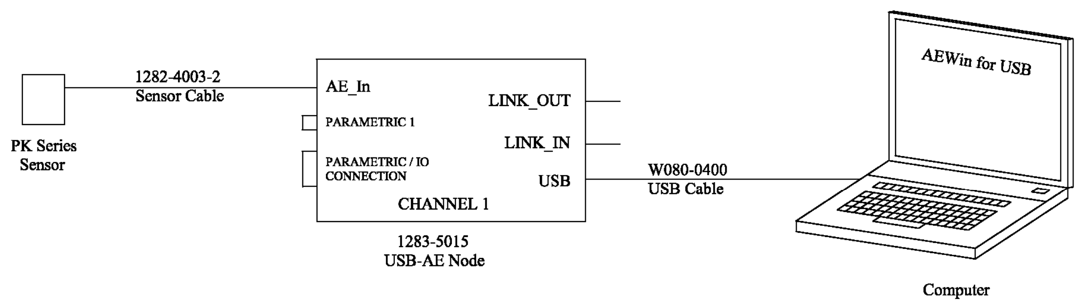

Figure 7. One Channel Integral Preamp System

3.3.2.1 Configuration for Switching between Passive and Active Sensors:

Rev 1 and above: There are two jumpers located on the 1283-2014 board itself that determine whether the USB Node will expect an active or a passive sensor to be attached. USB Nodes are shipped ready to be integrated with a passive sensor by default, i.e. a sensor from the Alpha family.

Please follow these steps to switch the internal preamp off and to enable phantom power so the USB Node may be used with an external preamplifier:

Unplug the unit from any computer or sensors to which it is attached.

Unscrew the Philips-head screws located on the four corners of the unit's enclosure surrounding the AE and parametric inputs. This is the unit's front panel.

Following proper ESD precautions (ground yourself before performing any of these steps, and remain grounded by holding onto any of the exposed metal parts on any of the unit's external connectors), slide the 1283-2014 USB Node's PCB board out from the enclosure by gently pulling on the front panel which you have just unscrewed.

Remain grounded with one hand, and locate jumpers P1 and P2 on the top layer of the PCB board. The shunts on both of these connectors will be found to connect pins 2 and 3 of each respective jumper by default.

In order to disable the internal preamp and to enable phantom power, these shunts must be removed and reattached on pins 1 and 2 of both jumpers, P1 and P2. Likewise to re-enable the internal preamp these shunts must be removed and reattached to pins 2 and 3 of both jumpers.

Once the shunts have been moved to your required location, gently slide the PCB board back into the enclosure and resecure the four screws to hold the front panel in place.

Continue to use the system as before.

3.3.3 Configuration for Multiple Channels

Figure 8 below shows a typical Multiple Channel configuration of USB-AE Nodes. This configuration is best used when testing larger components with multiple points of monitoring, interest, or when your test requires precise timing of hits so as to use the optional source location.

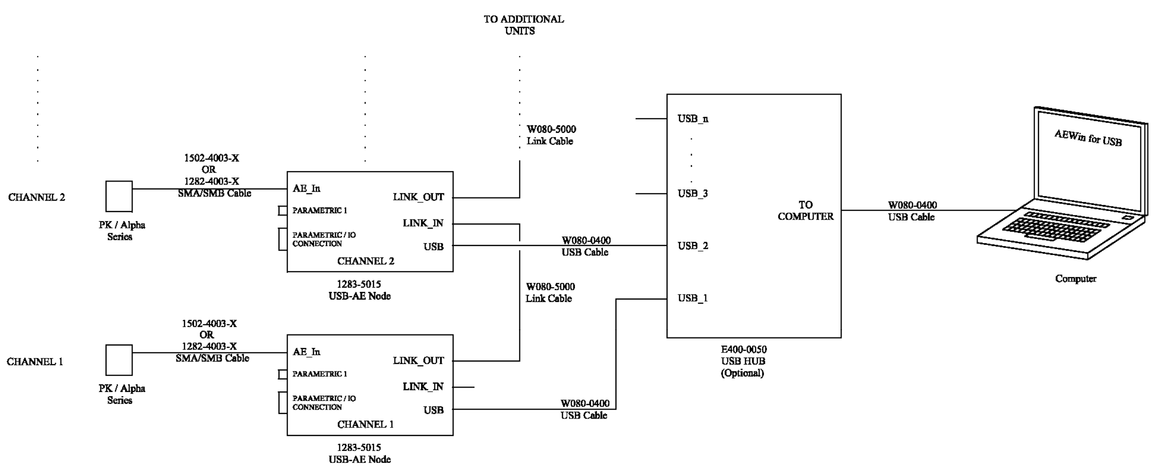

Figure 8. Typical Daisy-Chain Configuration

In this configuration one node is set to be the master and all other nodes in the chain are slaves. The master sends timer reset signals to the other nodes, one per second, to keep maximum timing accuracy between nodes. This is crucial in multi-channel systems in order to keep location calculations as accurate as possible and to ensure that all readings are synchronized between nodes. Each node's channel information is set in the factory. Following figure 8, the USB-AE Nodes are set up identically as that in the single channel setups described previously in terms of the sensor connections. For USB connections, if there are enough free USB ports on your computer, you may plug the USB-AE Nodes directly to your computer and in that case will not need a hub as shown in the diagram. However, if you do not have enough free USB ports, you will then need to procure a USB Hub (we recommend that you purchase this from MISTRAS-PAC since not all hubs are the same, however ours are guaranteed). The last connection shown is the daisy chaining of the Time-Sync cables. If your application requires source location, you will need to connect these time-synchronization cables, however, if you do not need location and want to use your AE system in independent channel mode, then you do not need the Time-Synchronization cables. For cases where you do need the time-sync cables, you connect them up as shown in the figure 8. As can be seen, since channel 1 is the Master, there is no "Link-In" connector, just a "Link-Out". This gets attached to the Link-In of the next, channel 2, USB-AE Node, and a second cable is attached to the Link-Out of the second channel and into the Link-In of the channel #3 Link-In connector.

4. INSTALLING THE USB NODE AND AEWIN INTO YOUR COMPUTER

If you have purchased your computer along with your USB-AE Node, your USB Node and AEwin have already been installed on your computer with an AEwin Icon on the desktop of the computer. In this case, you can skip over this section and proceed to the "Operating Your System" section of this manual. However, if you will be using your own computer with the USB Nodes and if it has not already been configured for the USB-AE Node or AEwin, then you will need to follow the instructions in this chapter before you can begin to use your system.

As with any USB device, your USB-AE node needs to be installed into your computer before it can be utilized as an AE system. There is a two step process involved. The first step is to install the USB-AE Node(s) into the computer and the second step is installing and licensing AEwin (or AEwin for USB) into your computer. This will be covered in the remaining sections of this manual. Please follow them step-by-step.

4.1 Installing your USB-AE Node into your computer

If you have purchased the USB-AE Node(s) and are planning on using your own computer that has not been configured at the factory, you will need to follow the steps below to install the USB-AE Node in order to be recognized by the computer.

The USB-AE Nodes require a driver in order to function properly in Windows.

Normally, after installing the node Windows will prompt for a driver for it. Point Windows to the appropriate driver folder on the CD and follow the instructions.
The driver folders are located on the CD at the following locations:

- **USB AE Node** – Drivers\USB AE node

Windows XP should detect that new hardware has been installed and start the Found New Hardware Wizard asking whether to connect to Windows Update.

1. Select 'No, not this time'. Press 'Next'.
2. Select 'Install from a list or specific location'. Press 'Next'.
3. Select 'Search for the best driver in these locations'.

   Insert the program CD in the CD drive.

   Check 'Search removable media'.

   Press 'Next'.

4. Windows will search for the required files and then display the 'Hardware Installation' window.

   A warning is displayed that the software has not passed Windows Logo testing.

   Press 'Continue Anyway'

5. Windows will install the driver files. Please wait for a few minutes.

6. When installation is finished the 'Completing the Found New Hardware Wizard' dialog box will appear.

   Press 'Finish' to complete the installation.

The procedure above is needed the very first time a USB AE node is attached to the computer. After that, if other nodes are attached or the first node is moved to another USB port, the following simpler procedure can be used. In step 2 above select 'Install the software automatically' and press 'Next'. Then, Windows will use the driver files already installed in the computer and jump to step 4 without reading the CD again.

If for some reason you need to install a driver manually then read the document drivers.doc found in the appropriate driver folder. Use the procedures described there only if the above automatic driver installation does not work. It is not normally required to install the driver this way but, if problems arise, that is how to do it.

4.2 Installing and Licensing AEwin On a Computer

If you are installing AEwin yourself, you will need to follow the simple installation instructions below. Software installation and licensing is a two step process which will be discussed in the next two sections for an example of "AEwin for DiSP" which is very similar to the "AEwin for USB" software installation. The AEwin program is generally pre-installed on the AE system computer from the factory. In special instances, such as where you are using your own computer, you will need to perform the installation yourself from the supplied CD. You cannot run AEwin directly from the distribution CD because the files on the disk are compressed and security protected.

If you are installing AEwin yourself, you will need to follow the simple installation instructions below. Due to the built-in software security features of this software, part of the installation process requires you to obtain an activation code from Physical Acoustics Corporation. The process is simple, you will be prompted to either call the factory or email the factory to obtain your security activation code, which you will enter to complete the installation process. This is all explained in the below example.

To fully install AEwin, you must perform the following steps, after you have exited all running applications.

1. Run SETUP.EXE from the root directory of the AEwin installation CD disk.
2. Activate the software using one of two methods:
   a) On the last screen of the setup program there is a checkbox for product activation. If this is checked when you press finish it will run the activator program automatically.
   b) To run the activator program manually it can be found at:
      Start Menu-->Programs-->Physical Acoustics-->Activate AEwin for DiSP

Each step in the process is described below.

4.2.1 Installing AEwin from the installation CD:

Insert the AEwin installation CD into your AE System (or PC computer). Using your mouse or keyboard, select:

Start → **Run** → and type or select **D:setup.exe**
(If your CD is other than drive D: enter that letter).

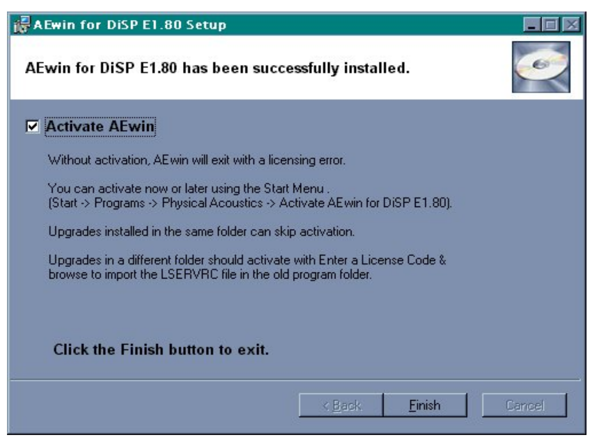

Figure 9. Installation Screen

Upon executing, you will follow a typical Windows installation process. Select all the default directories (highly recommended but not mandatory) if desired. Upon completion, of the installation, you will see the "Setup Complete" window as shown in figure 9. Note the comments and remaining steps that must be carried out. In most instances you will need to Activate AEwin before you can run it. This process can be started automatically by checking the 'Activate AEwin' checkbox before clicking Finish.

4.2.2 Activate the AEwin software using the Start Menu option

To manually activate the AEwin software, you must first select the "Activate AEwin" program. Do this by using your mouse to select the following;

Start → Programs → Physical Acoustics → Activate AEwin

This brings up the AEwin Activation screen as shown in figure 10. Selecting "Continue" will bring up the "Activation method selection" screen, shown in figure 11.

You have several methods in which to Activate AEwin _ "Telephone", "Email" and "Enter a License Code".

If you have a "Hardware Security Key" then much of this process has already been completed for you. A License Code has already been generated for you and is stored as a file ("lservrc") on your "Hardware Security Key" CD. Use the "Enter a License Code" method to activate AEwin.

If you do not have a "Hardware Security Key" then you will need to obtain a license code from PAC customer service. AEwin can be activated in this manner through either the "Telephone" or "Email" methods below.

You can "activate by telephone". If this method is selected, you will see a menu as shown in figure 12 which provides you with a telephone number to Customer Service who will help you and provide you with a License code that you can enter in while on the phone.

You can "activate by email".

Upon selecting this choice you will see the screen as shown in figure 13.

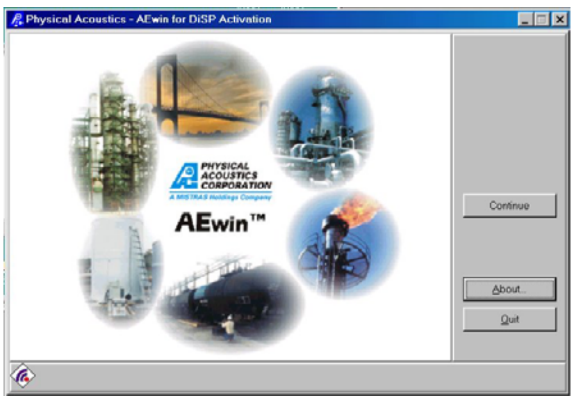

Figure 10. Activation opening screen

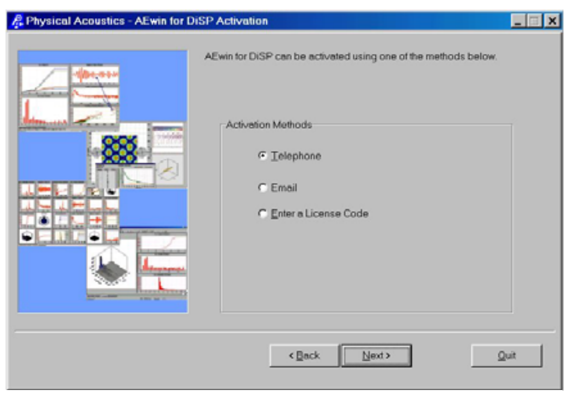

Figure 11. Choose Activation method

Your system will need to be able to access the internet to use this option. If it is internet ready, this is the easiest option to use. Just fill out all the information and press "Send Email". Your activation information will automatically be sent to customerservice@pacndt.com and your license code will be sent back to you as an email attachment.

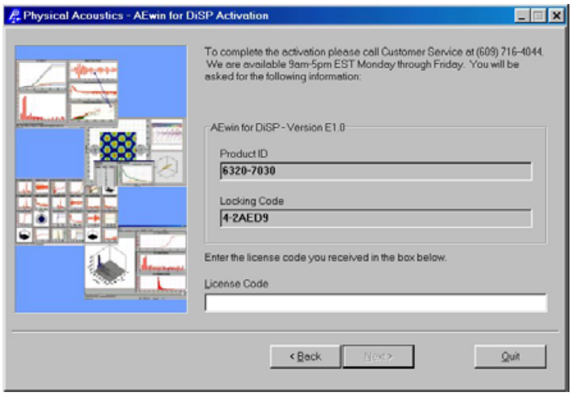

Figure 12. Activation by telephone

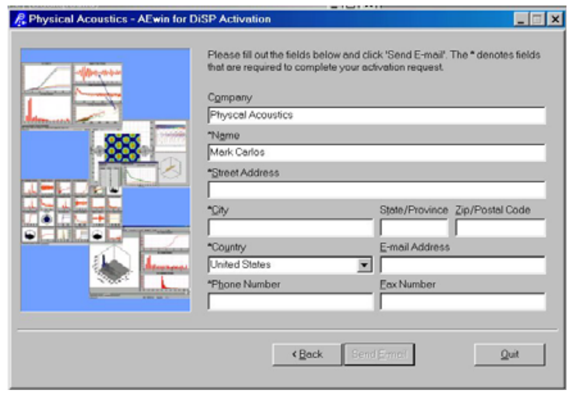

Figure 13. Activation by email

The last way to activate AEwin is by entering a license code. This method is selected once you receive your Email with the License Code or if you have written down the license code and wish to install it. Upon selecting this activation method, you will see the screen as shown in figure 14. This is a little different that that shown in figure 12 as you can either enter a number directly or you can choose the file folder just to the right of the License Code text entry box. Using the file to automatically enter the License Code is preferred to avoid making entry mistakes with the long license code number. Just select the file folder to enter a file. A screen as shown in figure 15 appears in which to select your license code file. Find the license file with the name LSERVRC and select it and the code will be entered automatically.

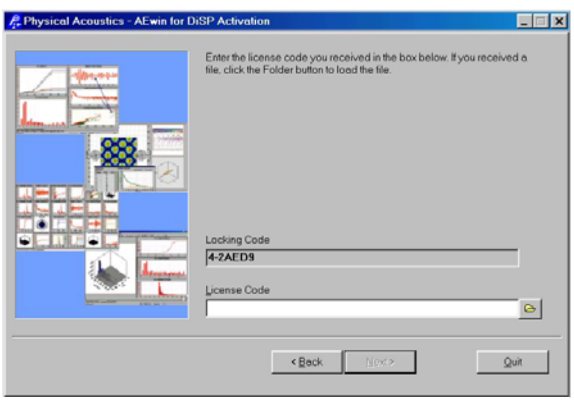

Figure 14. Enter license code screen

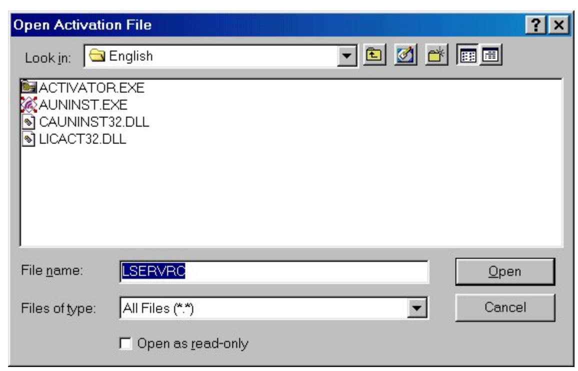

Figure 15. Selecting the LSERVRC license file

Once the License code is entered using any of the above methods, just press NEXT to continue and complete the activation process. This is it. AEwin is now installed.

At this point, your AEwin software is ready to run as a Replay program by selecting;

Start → Programs → Physical Acoustics → AEwin

4.3 Starting AEwin

The first step in the process of using AEwin is booting up the program on your AE system. As the AEwin program is a standard Windows program, it is started in the same way as any other WINDOWS program. This is accomplished either by using the "Start" command or by selecting the AEwin Icon from the WINDOWS desktop.

It is assumed that the AE computer is booted up and in its opening screen which is the desktop layout showing all the available program icons to select. If the PAC AEwin icon (as shown on the right) is on the desktop, all you need to do is select this by double clicking the left mouse button, once the mouse is positioned over the icon. If the icon is not on the desktop you can create the shortcut by referring to section 1.2.6 of the AEWin User's Manual.

AEwin

Alternatively you can start AEwin by selecting the following sequence starting with the Start menu at the bottom left side of the screen:

Start → Programs → Physical Acoustics → AEwin

The boot-up sequence for AEwin starts by loading the executable program AEwin.exe. Once AEwin is loaded, the program searches the startup "AE Data" subdirectory for the default Layout (setup file) called "Layout.LAY". Upon finding this file, AEwin loads it and becomes fully configured and ready to run in accordance with the setup information in that default Layout.LAY file. If no Layout.LAY is found, AEwin chooses a common default starting setup that is ready for use. In either case an AEwin startup screen similar to figure 16 will appear.

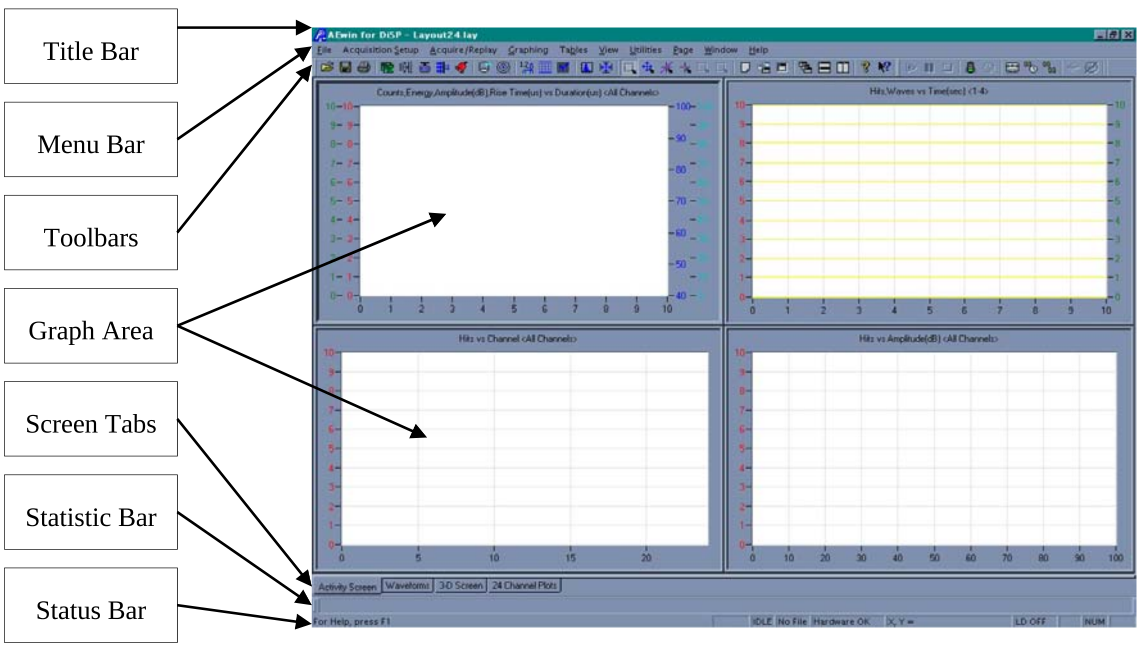

Figure 16. AEwin Opening Screen

4.4 AEwin Screen Layout Familiarization

Figure 16 shows a typical 4-screen layout for AEwin. Above and below the graph area are various informational, status and setup toolbars. Each bar is labeled with a name. Depending on the preferences selected for your program, you may have other toolbars or be missing some. The "View" menu in the main menu bar area controls which bars are on or off. The following is a short description of each area identified on the AEwin screen. This section will get you familiar with the layout and the overall function. Further chapters will provide detailed insight into the use of each of these functions.

Title Bar: This is a typical WINDOWS Title Bar with all the standard capabilities. At the leftmost position is the Physical Acoustics Logo (PAC Logo) Icon from which you can manage the AEwin program with functions such as minimize, restore, maximize, move, size or Close the program altogether. At the far right are the application buttons for Minimize, Restore and Close. Back on the right hand side next to the PAC Logo Icon is the program name (in this case it is AEwin for DiSP) and next to that is the name of the current layout file being used by the program. If an asterisk (*) appears next to the file name, it indicates that one or more settings have been changed since the last time the layout file was loaded or saved.

Main Menu Bar: The main menu bar provides a series of text commands running across the line, including: File, Acquisition Setup, Acquire/Replay, Graphing, Tables, View, Utilities, Page, Window, and Help. Most of these items contain pull-down sub-menus of their own, many of which in turn contain graphical dialog boxes and prompts of their own. You narrow down the range of choices until you arrive at the specific choice you want.

To display a pull-down sub-menu from a main menu entry, simply move the mouse pointer to the name of the menu item on the menu bar and click the left mouse button. This process is known as "clicking" (or "left-clicking") on an item, and will herein be referred to as such. To use the keyboard, simultaneously press the ALT key and the underlined letter of the menu item name at the same time. Once you have opened a pull-down menu item from the main menu, you can use the left and right arrow keys to move through each entry, allowing you to see the pull-down menu for each main menu entry. You can also use the up and down arrow keys to move through each selection of the pull-down menu. To select an item from a pull-down sub-menu, click on the desired action, or use the up and down arrow keys to select an action, and then press ENTER. Pressing the underlined letter of a menu item will also select that item. If an item in the pull-down menu appears "grayed out," this action is not available in the current software or at the current time. Use the <ESC> key to remove the pull-down menu display.

Most of the selections in the pull-down sub-menus will display a dialog box requesting information necessary to carry out the command you requested. A dialog box contains areas where you enter information, select options or commands, or activate controls to execute or cancel a command. There are several types of boxes and buttons available within a dialog box. These boxes and buttons are described briefly below and will be described in further detail in subsequent sections of this manual. It is important that you be familiar with dialog boxes and be comfortable using them, for they are the means by which most functions are carried out in the AEwin software.

Icon Toolbars: Many of the menu items accessible from the Main pull-down menus can also be accessed by use of the Icon Toolbar and Acquisition Control Toolbar just below it. Figure 17 shows the Icon toolbars.

Figure 17. Icon Toolbars

To determine the function of any of the Icon's simply move the mouse cursor over top of the desired icon. Upon resting there for approximately 1 second the Icon's function will appear. To select an icon as a shortcut command simply click on it with the left mouse button.

Graph Area: The graph area is the most important area of the screen. This is where the AE information in the form of graphs and line listings appear regarding the AE examination status. The graph area can be set up in many ways with a minimum of 1 graph to a maximum only limited by the graph visibility. More about the graph setup, functionality and flexibility will be discussed later in the Graph setup menu.

Screen Page Tabs: AEwin can show many different graph screens, these are called screen or graph "Pages". Accessibility to viewing any screen is provided via the Page tabs located just below the graph area. The Page tabs can be named to be synonymous with the graph theme as shown in figure 16 with the 4 Page tab names, Activity Screen, Waveform Screen, 3D Screen and 24 channel plots. Using the right mouse button and clicking on a page will display a 'context' menu from which pages can be added, inserted, deleted or renamed. The context menu is also a quick way to add new graphs and close existing graphs.

Statistics Bar: This toolbar area is reserved for display of test statistics. Test statistics allow the user to view key Acoustic emission test indicators including: Cumulative AE counts, Total AE Hits, Total AE Events, Total # Waveforms, Cumulative Counts, Cumulative Energy, Time of Test, Disk Free Space, Parametrics and others. These are very useful activity indicators during a test and very useful summary statistics after a test. The user can select any or all of these to customize his statistics display bar.

Status Bar: The Status bar provides useful information regarding AEwin and test status. On the left is a Text bar providing status and help information regarding the functions being carried out. Near the center is a status bar. In figure 16 the word "Idle" appears in this bar. Other status information such as "Test Paused", "Replay", "Test Stopped" "Test Active", "Abort Test", etc. are displayed in this text field. Next to the Test status field is a filename field informing the user the name of the file being replayed or the name under which an AE test is being saved. Next to that is a system diagnostics text field. In figure 4, this status is "Hardware OK". Next to that is a cursor position, showing the current location of the Cursor on the graph. When selected, the X, Y position will be read out in actual screen units.

4.5 Acquiring AE Data with AEwin for the First Time

This section is provided to help you understand the sequence of getting into and running an AE Test for the first time using the provided Layout (.LAY) files and also gives you insight into a more detailed sequence of carrying out an AE data acquisition test. Before starting in acquisition, you should have your AE system already set up as per the previous chapters of this AE system manual. This usually entails, connecting sensors, preamplifiers and cables to the AE system, connecting up your AE system, computer keyboard, mouse and monitor and booting up your system into AEwin as previously instructed. If you are not ready to connect up the AE system to conduct some type of AE test or at least any AE experimental test on a laboratory test, then skip this section and proceed to the next major section on Replaying an AE test with AEwin.

The key to carrying out an AE test is in setting up the hardware set-ups, graphics, location setups and display modes to your particular requirements prior to entering the test. Although there are many set-up items and they might seem confusing for first time users, PAC supplies good default set-ups for most typical tests and they are an excellent starting point. As you get more familiar with the system you can modify these set-ups a little bit at a time and save your new layout (.LAY) setup files for your next AE test. This small step-by-step "Trial and Error" approach builds up your knowledge base until you are totally familiar with all the set-up options and what they mean. Until you get this knowledge please depend on the PAC prepared .LAY files.

The following are the steps that should be taken when carrying out your first AE test using the PAC supplied layout files. First we will outline the steps and next we will carry them out.

1. Load the appropriate system Layout (.LAY) file into the system in order to set-up the system to your desired operation and display conditions. We will be using the standard **Layout4.LAY** layout file in this example which sets up 4 channels for acquisition.
2. Enter the Acquire menu.
3. Select the datafile name which you want to save to disk.
4. Start Acquisition.
5. Look at various screens, graphs and data listings during acquisition.
6. Exit data acquisition.

The following is the step by step detail on starting and running your first AE test. We assume that you have sensors set up and will be exciting them in order to generate signals for AE generation or have them attached to a structure, bar or plate with a pulser or some type of simulated AE source.

4.5.1 Loading a Layout File into AEwin

From the Menu bar, use your mouse to select **Files** then select **Open Layout...** A menu window called **Open** comes up. With your mouse, select the **Layout4.LAY** file from the list of layout files so that this file name appears highlighted in the file box next to **File Name:**. This selects the Layout4.LAY as the layout file that will set up the AE hardware for a 4 channel operation with a good, complete default set-up. To finish the sequence, move the mouse to the **Open** box area on the right side of the **Open** window box and click on it (left mouse key) or press <ENTER>. Upon executing this menu, the **Layout4.LAY** Layout file is read into the program. If you had made any changes to the current layout file, a message box will pop up asking you if you want to save the changes. If yes, select yes, if no, select no. AEwin will then load and configure itself to the **Layout4.LAY** setup. This completes the reading of the LAY (AEwin setup) file.

4.5.2 Entering Acquisition

Entering acquisition involves steps 2, 3 and 4 of the above sequence. To begin, left-click the mouse on the **Acquire/Replay** main menu item then click on the **Acquire** selection. Alternately, you can enter the Acquire function by pressing the **F9** function key (on the keyboard), or you can select the Acquire icon in the Acquire/Replay toolbar (see figure 27 for identification of the acquire, function key). The Acquire icon is shaped like a traffic light with the green light showing indicating that AEwin is ready to go into acquisition. This toolbar is usually to the right of the main icon toolbar or just below it. If you do not see this small 5 icon toolbar (like that shown in figure 18), it may not be turned on from the **View** menu. To activate it, simply select the Tools menu and make sure the "Acq. Controls" entry is checked. If not, click on it and it will be activated and will show up with the other toolbar icons.

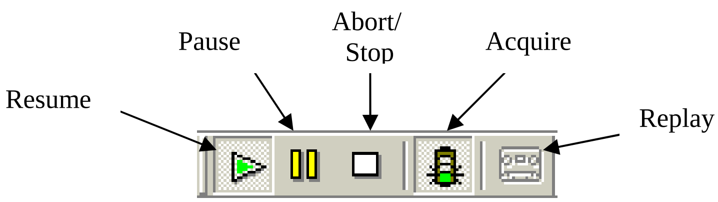

Figure 18. Acquire/Replay Icon Toolbar

Once you have selected the Acquire function, a **Test Storage** files menu box will appear to signal you to enter a data file name and whether you want to save the file to disk. (An example of the Test Storage file menu box is shown in figure 19.)

First, make sure the "Save to DTA file **(Autodump)**" box is checked if you want to save the data you will be collecting in this exercise. In AEwin, this is always automatically checked and you usually have to deselect (uncheck) it to prevent the generation of an AE data file.

Next, check the name shown in the **File Name:** box. If that name is acceptable then you are ready to start the test by clicking on the **OK** button. If you want a different name then enter the new name by typing it in when the **File Name** box is highlighted. Once you enter the name (you do not have to enter the .DTA extension) you can hit <ENTER> on the keyboard or click the **Start** button (located to the right of the Filename) with the left mouse button to begin acquisition. At this point AEwin enters the acquisition screen and waits for you to press the <ENTER> key to start the test. Press <ENTER> to start Acquisition.

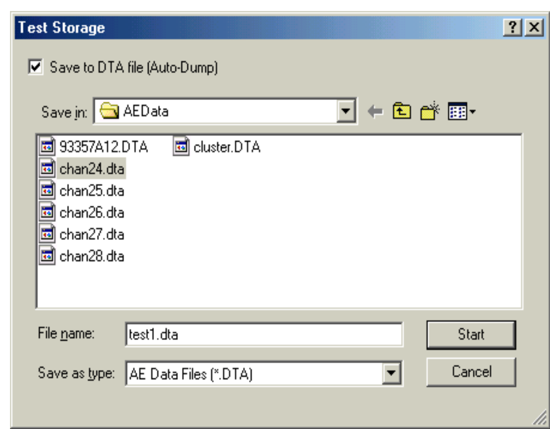

Figure 19. Test Storage Files Selection Menu

The system is now in data acquisition and is collecting and displaying AE information and displaying it on the graphs. Tap the sensor against the table your instrument is set up on or scratch it with your fingernail.

At first you will see no change in your Data Acquisition Graph but once the amount of time specified in **Test Setup → Display Mode** menu parameter "Seconds between Update" time has elapsed (it is usually set for 1 – 2 seconds), you will begin to see a visual representation of your data. Continue tapping the sensors to see the changes to the graphs to verify that you are getting waveforms and graph updates. An example plot showing the first AE graph screen page (selecting the tab, Activity Screen), is shown in figure 20. You should be seeing data visualization like that shown, where graph 1 shows a group of 4 point plots including Counts, Energy, Amplitude and Rise Time (on the Y-axis) versus Duration (on the X-axis), graph #2 (to the right) is showing #AE hits and #waveforms collected versus time, Graph #3 (below graph 1) is showing Hits versus channel and Graph #4 (lower right) is showing the

Hits versus Amplitude (or Amplitude Distribution). By selecting the "waveform" tab at the bottom of the graphs you will see a display of waveforms and their associated FFT's like that shown in figure 21.

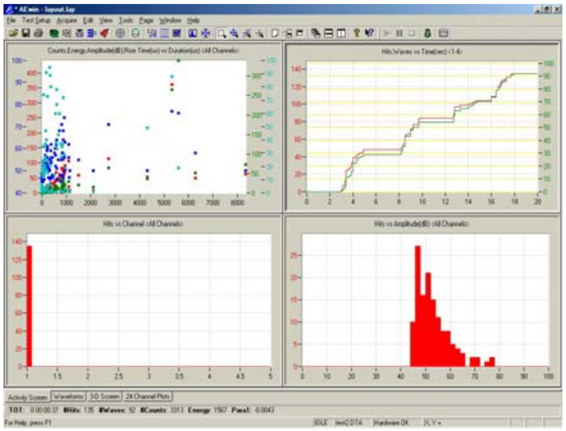

Figure 20. Example Activity Screen

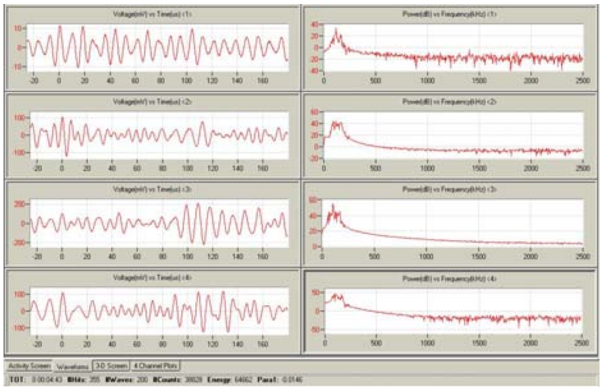

Figure 21. Example Waveforms Screen

This provides a short example of how to start your AE system with AEwin software. For more detailed information about the complete operation of AEwin, please refer to the next section of this manual, Getting Familiar with the AEwin Menus" or refer to the Help Menu's in AEwin software directly.

4.6 Getting Familiar with the AEwin Menus

This section provides a detailed reference of AEwin's major menu items and dialog boxes. The first time through, we suggest you just look at the menus (to get familiar with them) and use the setups provided with your AEwin installation, that have been predefined by PAC; later, you can make your own choices within the menus to control system operation.

From the Opening Screen (Figure 16), pay attention to the Main Menu Bar near the top of the screen. This specific area is shown again below. Each main menu item will be described. This brief introduction to navigating the menus is provided in order to get ready for guiding the user in the sequence of starting and replaying a test.

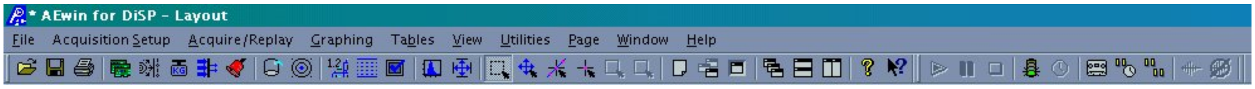

Figure 22. Main menus and toolbars

4.6.1 File Menu

4.6.1.1 New Layout

The 'New Layout' menu item is used to remove all graphs and pages and restore the graph layout to a default setting of one page and one simple graph. This command does not alter any other settings.

4.6.1.2 Open Layout…

The 'Open Layout…' menu item is used to load a specified layout file's setup information into AEwin.

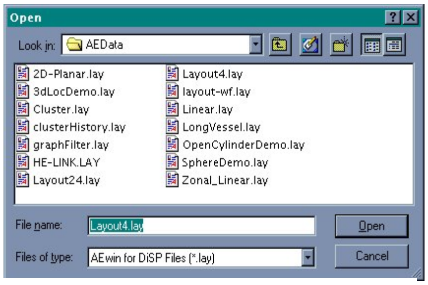

Figure 23. Open Layout…

4.6.1.3 Save Layout/Save Layout As…

The 'Save Layout…' and 'Save Layout As…' menu items are used to save the setup information in AEwin to a specified layout file. When the 'Save Layout As…' item is clicked the 'Save As' dialog is displayed. Here you can enter a new layout filename to create or an existing one to overwrite. Once this is done you will see the layout filename you entered on the upper left corner of the screen. You can use 'Save Layout…' from then on to update the file with any changes you have made since you have last saved.

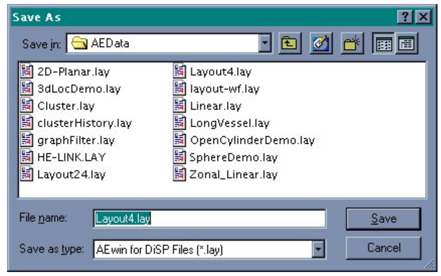

Figure 24. Save Layout…

4.6.1.4 Specify Data Folder…

The 'Specify Data Folder…' menu item opens a dialog box of the same name. It is used to select the default folders for storage of Data and Layout files. These are the folders that are displayed by default in the various Open/Save Layout and Acquire/Replay dialog boxes. The 'Layout File Folder' is also where AEwin looks for the autoload 'Layout.lay' file on startup. By default these are both set to the AEData folder found in the installation folder of AEwin.

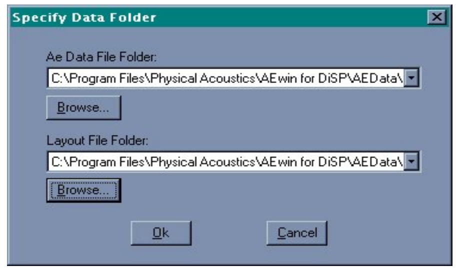

Figure 25. Specify Data Folder

4.6.1.5 Print Page(s)/Print Graph…

The 'Print Page(s)…' and 'Print Graph…' menu items are used to print a graph or multiple pages of graphs. 'Print Graph…' is used to send the currently selected graph to the printer, zoomed as much as possible while still retaining aspect ratio. 'Print Page(s)…' is used to send a selection of pages to the printer one page at a time, each page zoomed as much as possible while still retaining aspect ratio. You can select 'All pages' or a range of pages.

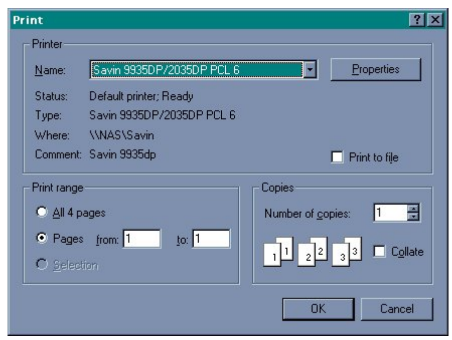

Figure 26. Print…

4.6.1.6 Export to JPG…

'Export to JPG…' is used to save pages as JPEG files in the same way that 'Print Page(s)…' sends pages to the printer. Here you enter a base filename and a destination folder. Each page will be saved as a separate JPEG file with its name formed from the combination of the base name and the page's title. e.g. If you had 2 pages named 'waveforms' and 'activity' and you set the base name to be 'TEST' then the two files will be named 'TESTwaveform.JPG' and 'TESTactivity.JPG'.

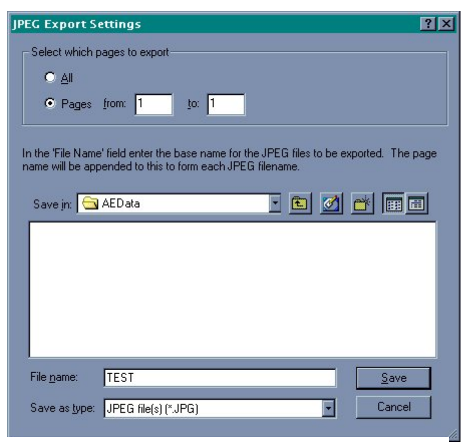

Figure 27. Export to JPG

4.6.1.7 Copy Screen to Clipboard

'Copy Screen to Clipboard' is used to save an image of the entire screen to the clipboard. This image can then be pasted in other applications such as word processors and image editors.

4.6.1.8 Exit

'Exit' is used to terminate the AEwin program. If you have made any unsaved changes to your current layout AEwin will prompt you to save your layout first, exit without saving or cancel.

4.6.2 Acquisition Setup Menu

4.6.2.1 Hardware…

This is the dialog box where all hardware settings are selected before the test. There are a number of property pages that each deal with a different part of hardware setup. Each is described below. Note that there are some differences in this dialog box between products. For instance 'AEwin for Spartan' has a Gain setting but no Waveform Setup whereas 'AEwin for DiSP' has no Gain setting but can have Waveform Setup if the Waveform option has been installed. Features specific to one or more types of hardware are noted by the names of the applicable hardware types. These types are briefly described below.

Name	Description	Waveforms
ICC	2 Channel card for **Spartan** systems. *	Not Available
DSP4	4 Channel card for **Spartan** systems. *	Not Available
AEDSP	2 Channel card for **Mistras** systems.	Standard
PCI-DSP4	4 Channel card for **DiSP** systems.	Optional
SAMOS	8 Channel card for **SAMOS** systems.	Standard
PCI-2	2 Channel card for **PCI-2** systems.	Standard
USB-AE Node	1 Channel USB Node for use with PC's	Optional

* ICC and DSP4 cards can be used simultaneously in the same system.

4.6.2.1.1 Standard Channel Setup

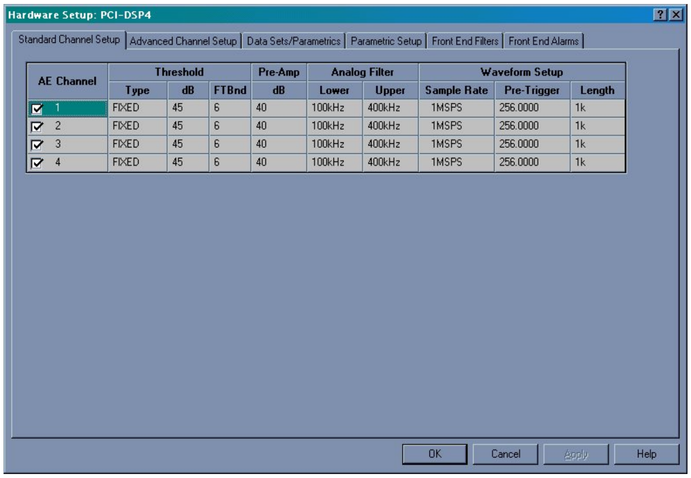

Figure 28. Standard Channel Setup

In the 'Standard Channel Setup' page you can enable or disable each channel and edit their common settings.

If your system has the waveform option installed you can also edit each channel's waveform settings.

AE Channel – You can enable a channel by clicking its checkbox.
Threshold – 'Fixed' threshold is used when you want the threshold to remain unchanged at the 'dB' level you set (in the dB column). 'Floating' threshold is used under conditions of high, varying background noise. When floating threshold is selected, the value shown in the 'dB' column represents the threshold level at the start of the acquisition, the threshold will vary to 6dB (or FTBnd value on systems that have this column) above the current ASL reading for that channel. The threshold will not go below the initial value specified in the 'dB' column. Threshold is the prime variable that controls channel sensitivity.
Pre-Amp (dB) – Enter the pre-amp gain of your sensor's pre-amplifier here.
Analog Filter [not available for ICC] – The Lower and Upper drop-down list boxes allow you to select from the available analog filter values for low pass and high pass filters on each active channel. This is done by simply selecting the desired value from the drop down list boxes. Note that if waveform analysis is desired, these values should be kept below ½ of the Sample Rate. Make sure to raise your Sample Rate if this becomes an issue.
Sample Rate [only with waveform option] – This is the rate at which the data acquisition board samples waveforms on a per second basis. A sample rate of 1 MSPS (Mega Samples Per Second) means that one waveform sample is taken every μsec. A sample rate of 2 MSPS means that one waveform sample is taken every ½ μsec., etc. The sample rate can be selected by clicking on the down arrow on the drop down list box, then clicking the mouse on the desired sample rate.
Pre-Trigger [only with waveform option] – This value tells the software how long to record (in μsec.) before the trigger point (the point at which the threshold is exceeded). The user may enter a value in μsec in the pre-trigger edit box. The minimum allowable pre-trigger value is zero. The maximum allowable pre-trigger value is calculated by dividing the hit length by the sample rate in MHz. If, for example, the hit length was 1 k (1 k = 1024) and the sample rate was 4 MHz, then the maximum allowable pre-trigger value would be 1024/4 = 256 μsec.
Hit Length [only with waveform option] – This determines the size of a waveform message. Clicking the down arrow on the drop-down list box for Hit Length will display a list of allowable hit lengths from 1 k to 15 k. At a 4 MSPS sampling rate, a hit length of 1 k will allow up to 256 μsec. of data, a hit length of 2 k will allow 512 μsec of data (2 * 256), and so on.

4.6.2.1.2 Advanced Channel Setup

In the 'Advanced Channel Setup' page you can enable or disable each channel and edit Peak Definition Time (PDT),

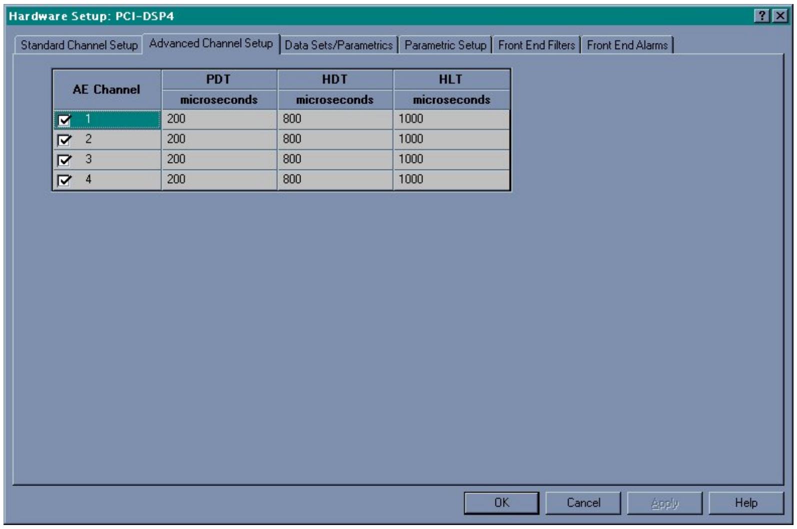

Figure 29. Advanced Channel Setup

Hit Definition Time (HDT), and Hit Lockout Time (HLT).

PDT, HDT and HLT are timing parameters of the signal measurement process. Their function is discussed in full in **Appendix 1**. In brief, a proper setting of the PDT ensures correct identification of the signal peak for risetime and peak amplitude measurements. Proper setting of the HDT ensures that each AE signal from the structure is reported as one and only one hit. With proper setting of the HLT, spurious measurements during the signal decay are avoided and data acquisition speed can be increased. Recommended values for general-purpose testing are:

	PDT	**HDT**	**HLT**
Composites, Non-Metals	20-50	100-200	300
Small Metal Specimens	300	600	1000
Metal Structures (high damping)	300	600	1000
Metal Structures (low damping)	1000	2000	20000

4.6.2.1.3 Data Sets/Parametrics

AEwin features user-selectable data sets. This means that if you do not plan to use all the measurable AE parameters, you can leave some out and enjoy the compensating advantages of higher data throughput speed and more economical use of storage space. Selecting Data Sets/Parametrics from the Hardware Setup dialog box displays the Data Sets/Parametrics page that follows.

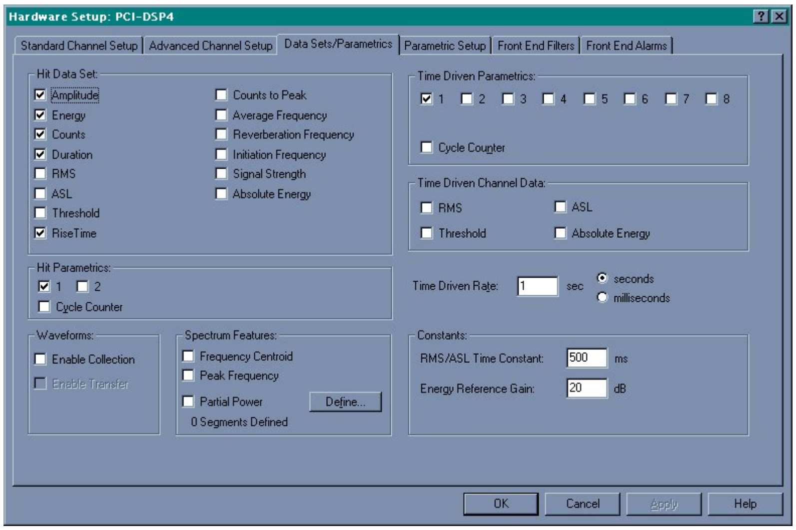

Figure 30. Data Sets/Parametrics

Note that the above figure is specific to the DiSP product. Your product may have more/fewer options available.

Hit Data Set
This box allows you to select which measured parameters are to be included in the description of each AE hit. The parameters to be included are so marked with a check in the checkbox next to the parameter. Parameters can be included/excluded from the data set by selecting or deselecting the checkbox next to the parameter. "Time of test" is not shown because it is always included in the data set.

Hit Parametrics
This box allows you to select which parametric inputs are to be included in the description of each hit. A maximum of two parametric inputs (e.g., external load signals), or one parametric input plus the cycle counter, can be included in the Hit data set. These items, however, must also be included in the Time Driven Data Set, otherwise an error message will appear.

Waveforms
This box is available if you have the waveform option installed.
Enable Collection – This checkbox is used to signal the data acquisition board(s) to acquire waveforms. If this checkbox is unchecked then the board(s) will not be able to collect waveforms for the duration of the test.

Enable Transfer – This checkbox is used to signal the data acquisition board(s) to transfer collected waveforms to the software for processing/display and (if auto-dump is enabled) saving to a data file. If this checkbox is unchecked then the waveforms will not be visible to the user and won't be saved in a data file until the checkbox is turned on. Unlike Enable Collection this checkbox can be toggled on/off at any time during a test. When Enable Transfer is OFF the system can experience a boost in performance especially at high data rates if you are saving to a data file. Turning Enable Collection OFF can grant a greater performance boost at very high data rates as the system concentrates on hit-based data.

Spectrum Features

This box is available if you have the waveform option installed. Spectrum Features are derived from the power spectrum of the waveform associated with a hit:
1) Frequency centroid - the center of mass of the power spectrum graph.
2) Peak frequency - the point where the power spectrum is greatest.
3) Partial Powers - see 'Partial Power Features' below.
You must check Enable Collection in the Waveforms box for these features to be usable. Transfer of waveforms can still be set off so that the system can record spectrum features without recording waveforms.

Partial Power – Partial Power is a feature which is derived from the power spectrum of the waveform associated with a hit. It is a percentage and is calculated by summing the power spectrum in a specified range of frequencies (up to four of these ranges can be specified), dividing it by the total power in another range of frequencies, and multiplying the result by 100.

To use partial power you must
1) Check the partial power checkbox.
2) Define at least one partial power segment. To do this press 'Define'. This brings up the Spectrum Segment Setup dialog box described below.

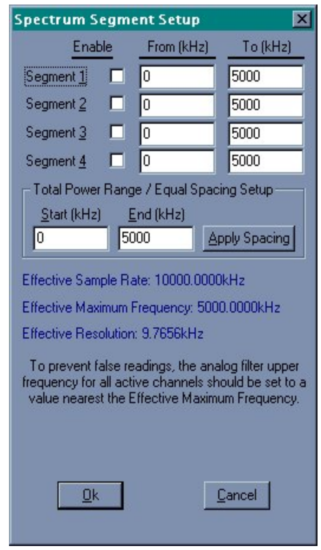

Figure 31. Spectrum Segment Setup

Spectrum Segment Setup is used to define the partial power features. For each of the 4 definable segments the dialog box has a checkbox to enable the segment, an edit box for defining the start frequency and an edit box for defining the ending frequency.

The group box titled 'Total Power Range/Equal Spacing Setup' contains two edit boxes. These edit boxes serve a dual purpose. The main reason for them is to define a range of frequencies over which the power spectrum will be summed.

The result of the summation is used in the calculation of total power for the partial powers calculation. Their other purpose is to allow the user to spread the frequency range evenly among the enabled segments. The spacing will occur when the user presses the 'Apply Spacing' button which is located to the right of the edit boxes.

CAUTION: If the edit boxes are used to set up equal spacing, always make sure the edit boxes contain the Total Power range values when the dialog box 'OK' button is pressed. Otherwise the partial powers will be based on the equal spacing range.

The dialog box also displays information based on the sample rate and hit length of the first active AE channel:
1) Effective Sample Rate – The sample rate of the decimated waveform (the FFT calculation is always for 1k of samples). For a 1k hit length the effective sample rate is the same as the hardware sample rate. For a 2k hit length it would be half the hardware sample rate. Etc.
2) Effective Maximum Frequency – This is one half that of the Effective Sample Rate and is the maximum frequency which can be defined for any segment.
3) Effective Resolution - This is the Effective Maximum Frequency / 512 and is equivalent to the frequency range of a single FFT bin.

The system does not automatically set the input filters based on the sample rate to reduce aliasing, so the dialog box will remind the user to set the input filter to a value closest to the Effective Maximum Frequency.

The Spectrum Segments are global for all active channels, if the sample rate and/or hit length is not the same for all active channels a warning will be displayed to alert the user.

Time Driven Parametrics and **Time Driven Channel Data**

Additional to the hit descriptions, AEwin allows the recording of RMS, ASL, Threshold, Absolute Energy, Cycle Counter and Parametric inputs, at regular time intervals even in the absence of AE activity. These are called Time Driven messages. This box allows you to select a set of features for them.

Time Driven Rate – This controls the frequency of the readings and the data to be included in the records. Time driven data is useful for leak monitoring and for recording changes in load and background noise levels. Also, time driven data can be used for updating hit data graphs, involving parametric values or time, even when no hits are coming in. The interval you set must lie in the range 10 msec to 1,800 sec and must be a multiple of 10 msec. Typical values are in the range 1000-60,000 msec (1–60 seconds). For frequent parametric value updates, you may like to choose a short interval, but this leads to lengthy disk files and data listings, so it is not necessarily the best choice. When the time driven data set is used to update graphs, it is a good idea to set the rate less than or equal to the 'Seconds Between Updates' field selected in the Display Mode dialog box.

RMS/ASL Time Constants

RMS/ASL Time Constant [not in DSP4/ICC] – The time constant can be set from 10ms to 1000ms in steps of 10ms. Previous versions of the program had a fixed time constant of 500ms.

4.6.2.1.4 Parametric Setup

The Parametric Setup page allows you to scale the voltages measured at the parametric input, such that the system displays the corresponding load or pressure values. This page also allows you to tell the system what units (kN, psi) you want displayed on your graph axis and printouts, and it allows you to select from four available filters on gain.

The Parametric Scaling process used by AEwin is: Displayed Value = (Measured Voltage x Multiplier) + Offset

The default values set up in the delivered Autoload file are 1.00, 0.00 and "Volts" so that the system will display the raw voltage delivered to the Parametric Input socket on the rear panel.

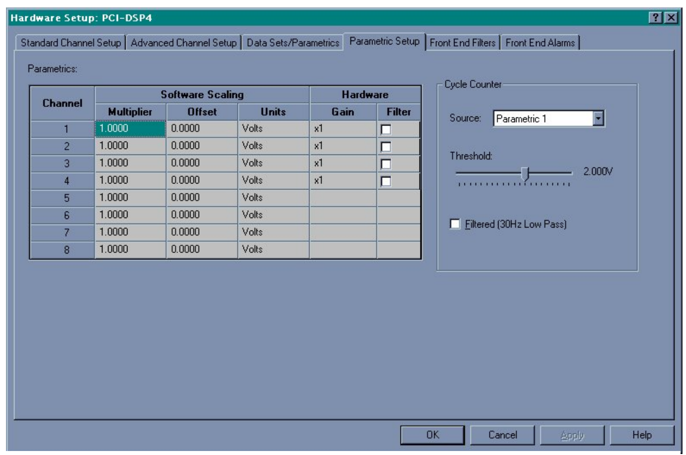

Figure 32. Parametric Setup

To scale the output of a linear load-measuring transducer, the easiest way to find the correct Multiplier and Offset is to go into a simulated test and turn on the Line Listing Display (F7). From the display read the parametric voltages for two widely separated loads. Suppose these readings are V1 at load L1, and V2 at load L2. The correct values for Multiplier and Offset are then:

Multiplier = (L1 - L2) / (V1 -V2)

Offset = (V1*L2 - V2*L1) / (V1 - V2) = L1 - Multiplier * V1

Once you click OK to exit this dialog the scaled values of the parametric input will now appear on all graph displays and data listings. Minimum and maximum values for graph axes should be specified in the scaled values, and the entered unit will appear on the graph (e.g., 0–1000 psi). The raw data on disk will contain the original voltage readings and the scaling will be done again each time the file is replayed.

This manual has been an introduction to the basics of the USB-AE Node Hardware and Software. In an effort to keep this guide concise there are many powerful features available that have not yet been touched upon. More information as well as full software documentation can be found in the AEwin Software User's Manual, PAC p/n 6320-1006.

5. SPECIFICATIONS

5.1 USB-AE Node System Specs

The USB-AE Node is a complete, one channel, 18 bit A/D, Acoustic Emission subsystem, controlled and operated by a powerful, internal microprocessor, communicating with a PC over a high-speed USB 2.0 data connection. AEwin for USB software allows the viewing and recording of all acquired data using the typical data sets expected of all of our full AE systems: Time of hit, hit rise time, hit duration, peak amplitude, counts, energy, waveforms, location processing, and parametric data acquisition to name a few. Some of the key specifications particular to the USB-AE Node are as follows:

Specification Item	Specification
Physical Specifications:	
Size:	1.25" High x 3.25" Wide x 5.25" deep (32mm x 83mm x 133mm)
Weight (with batteries):	0.5 lbs. (0.23 Kg)
Environmental Specs:	
Operating Temperature:	32° - 115° F (0° - 45° C)
Storage Temperature:	-4° - 140° F (-20° - 60° C)
Power Specifications:	
Power Requirements:	<100mA running @ 5V, supplied by PC's USB interface
External Interface:	High-Speed USB 2.0, 12Mbps
AE Channel Description:	Connector inputs. Single-ended or Differential signals accepted, and optionally amplified by an internal low noise amplifier. Additionally, 5V Phantom Power is available for use with PK Series, low power, integral preamp sensors for long distance applications. (internal jumper for selection between internal and external preamplifier).
AE Frequency Response:	1.0 kHz to 1.0MHz +/- 1.5 dB
Software Selected Filters:	The USB-AE Node system comes with High Pass and Low Pass software selectable analog filters and multiple digitally synthesized filters, providing exceptional filtering characteristics for maximum noise rejection and signal to noise.
Digitizing:	Internal 18 bit, 20 MSPS A/D for each channel
Digital Signal Processing:	Real Time, Digital, Low Pass or Band Pass filtering, multiple AE feature extraction (Each extracted feature is processed by a dedicated real-time, pipelined processor) and waveform recording and processing.
Extracted Hit Features:	Typical AE features including Time of 1st Threshold Crossing (Time of Hit), Time to Peak, Peak Amplitude, Signal Strength, Duration, Rise Time, Counts, True Energy, RMS, ASL, Parametric Input and calculated features including Average Frequency, Peak Frequency and Ring down frequency.
Parametric and Other I/O:	Eight channels available via a single DB-9 port, sampled by a 100kSPS, 16 bit A/D converter: • Pin 1: Parametric +/- 10 V input range • Pin 2, 3 & 4: Parametrics 2, 3 & 4, 0-10 V input range • Pin 5: Digital input • Pin 6 & 7: Analog outputs 1 & 2, 0 – 4.5 V programmable • Pin 8: Digital output
AST: • Internal Preamp • External Preamp	 • Pulse-Through, pulsing to crystal with programmable tone burst. • Trigger for external preamplifiers available on Phantom power.

6. APPENDIX I

6.1 System Timing Parameters (PDTR, HDT, HLT)

HQTS: P: (609) 716-4000 ● F: (609) 716-0706
195 Clarksville Road ● Princeton Jct., NJ 08550
www.mistrasgroup.com

APPENDIX I

System Timing Parameters (PDT, HDT, HLT)

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APPENDIX I

System Timing Parameters (PDT, HDT, HLT)

This appendix describes the purpose and functioning of the three timing parameters used in AE waveform measurements:

PEAK DEFINITION TIME (PDT) — Formerly known as Rise Time - Time Out (RTTO)

HIT DEFINITION TIME (HDT) — Formerly known as Single Channel Event Time-Out (SCETO)

HIT LOCKOUT TIME (HLT) — Formerly known as Re-arm Time Out RTO)

This appendix also offers methods for selecting values of these parameters for practical AE testing.

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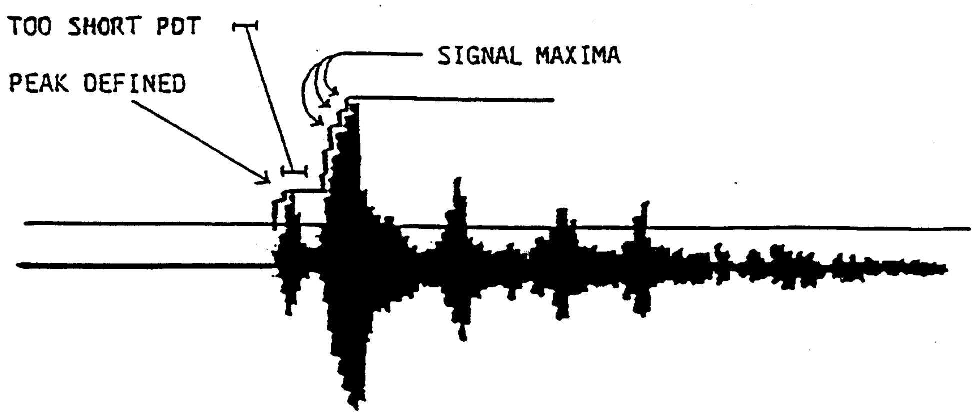
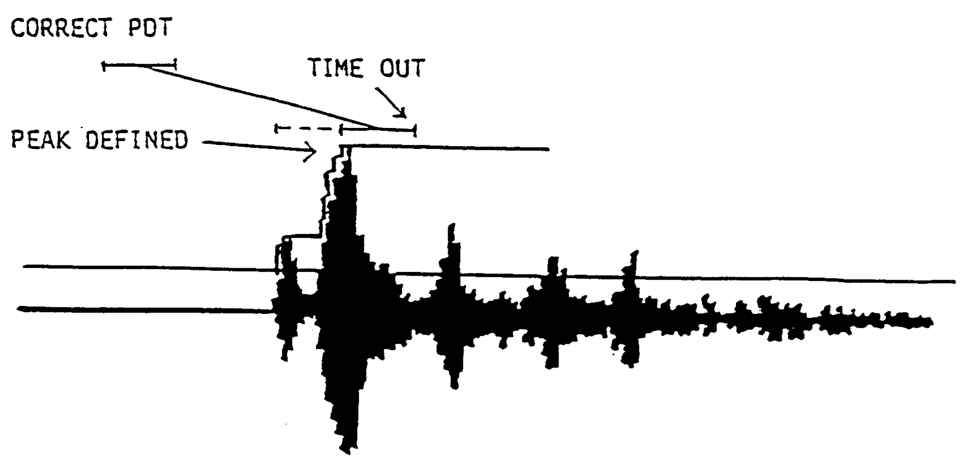
PEAK DEFINITION TIME (PDT)
Also known as RISE TIME OUT (RTTO)

The function of Peak Definition Time is to enable determination of the time of the true peak of the AE waveform. The PDT circuitry is a retriggerable one-shot, triggered by new signal maxima.





The main requirement is to avoid false measurements being made on a high-velocity, low-amplitude precursor. subject to this, PDT should be set as short as possible. A reasonable value to pick for PDT is D/C where D is the sensor spacing and C is the speed of the fastest wave, say 6mm/us.

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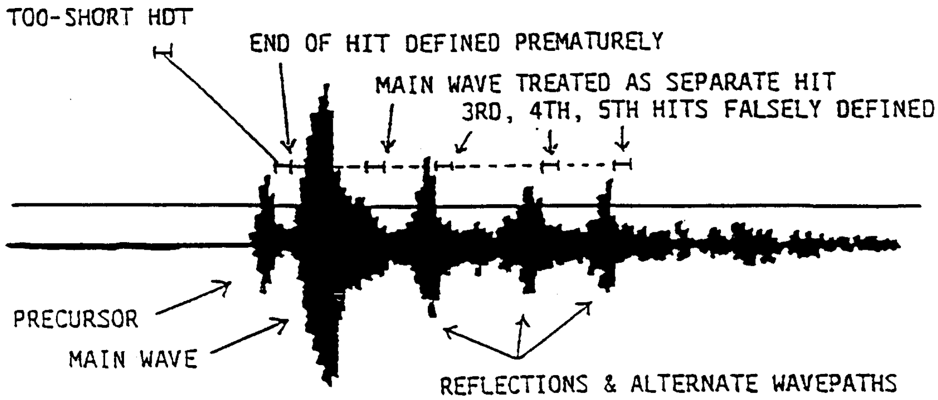
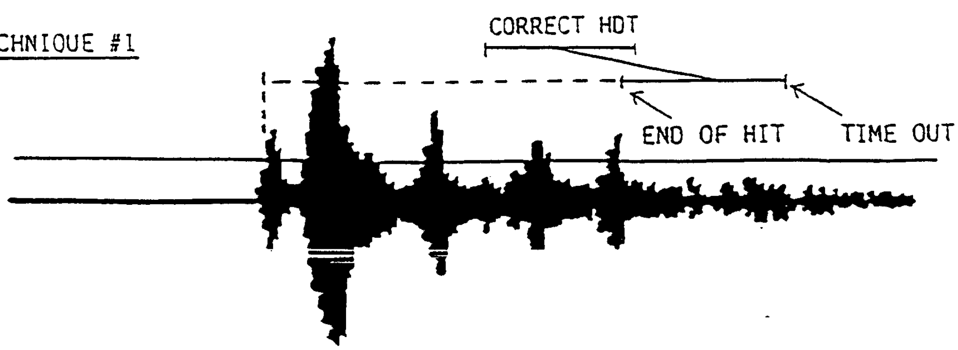
HIT DEFINITION TIME (HDT)
Also known as Single Channel Event Time Out (SCETO)

The function of Hit Definition Time is to enable the system to determine the end of the hit, close out the measurement processes and store the measured attributes of the signal. The HDT circuitry is a retriggerable one-shot, triggered by the threshold crossings. In most PAC systems the HDT must be at least twice as long as the PDT.



The goal is to identify and describe events realistically. The HDT must be long enough to span over an intervals in which the signal to be measured falls below the threshold. Subject to this, the HDT should be set as short as possible, in order to permit high data throughput rates and reduce the risk that two separate events will be treated as a single hit.

TECHNIQUE #1



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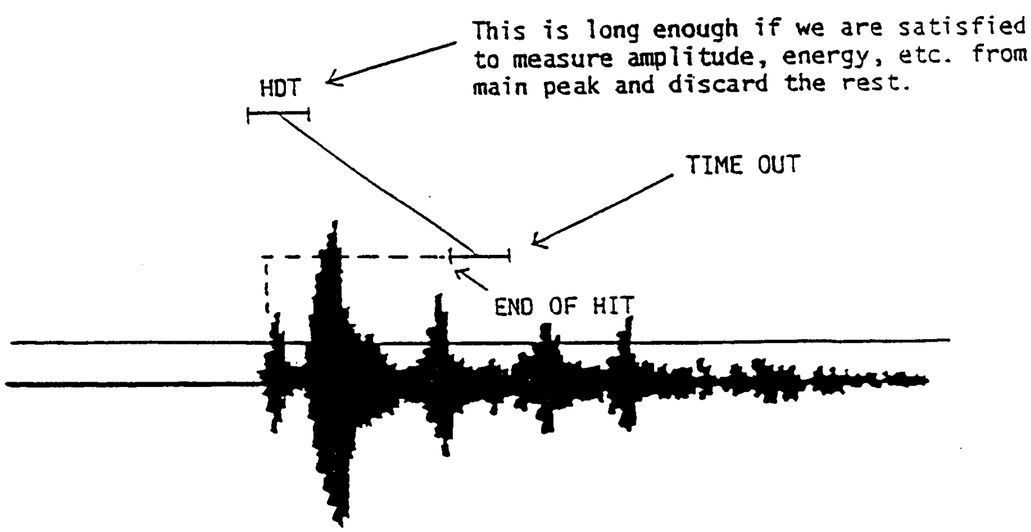
HIT DEFINITION TIME (Continued)

The idea of TECHNIQUE #1 is to include, in the hit description, all consequences (reflections, alternate paths, etc.) of the source event. This is the straightforward approach, using a relatively long HDT.

The reasonable value to pick for HDT is L/C where L is a characteristic length of the structure (e.g. circumference of a vessel) and C is the speed of a typical main wave (say 3mm/us); or 20/AC where A is measured attenuation coefficient (dB/mm); whichever is smaller.

The idea of TECHNIQUE #2 is that the system throughput can be improved by discarding "irrelevant" reflections, etc. and measuring only the main part of the wave.

TECHNIQUE #2

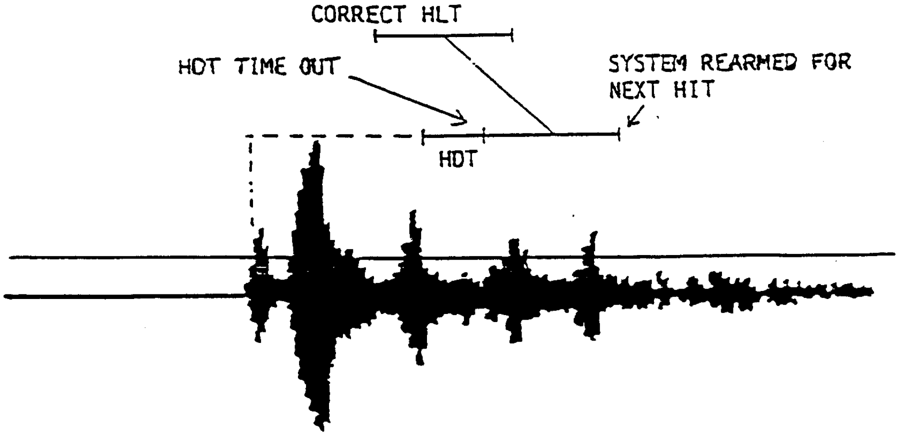


With TECHNIQUE #2, the system can clear buffers and get ready for a second hit while the reflections from the first hit are locked out by the HLT (next page). So the system is ready earlier for a second hit.

A reasonable value for HLT using TECHNIQUE #2 is 20/F where F is the sensor resonant frequency in MHz.

HIT LOCKOUT TIME (HLT)
Also known as REARM TIME OUT (RTO)

The function of Hit Lockout Time is to inhibit the measurement of reflections and late-arriving parts of the AE signal, so that data from wave arrivals can be acquired at a faster rate. The HLT circuitry is a non-triggerable one-shot, triggered by the time out of the HDT.



HLT is important only when using TECHNIQUE #2 for HDT selection. When TECHNIQUE #1 is used for HDT selection, HLT may be conveniently set to the smallest value permitted by the system.

When using TECHNIQUE #2, the HLT should be long enough to span any gaps between threshold crossings, especially the longer gaps that tend to occur in the tail end of signals from reverberant structures. A reasonable value may be picked using the same methods as for HDT (TECHNIQUE #1). HLT's shorter than about 300us will not be meaningful since it takes this time for the ICC to complete data measurements and transfer the results to its output buffer.