# Table of Contents

# Getting Started

# PDA Model PAX Overview

This manual focuses on the practical aspects of using the Pile Driving Analyzer® (PDA) model PAX to perform high strain dynamic tests on single deep foundation elements such as driven piles, drilled or bored shafts or auger cast-in-place (continuous flight auger, CFA) piles, hereinafter generically referred to as **piles**. Published papers containing case studies, applications, and the theory of high strain dynamic testing are available at http://www.pile.com/reference. Data acquired by the PAX is usually processed by the software program PDA-W. Please refer to the PDA-W documentation for further information.

NOTE: Files created by the model PAX may only be processed by the PDA-W version which was supplied with your unit.

The PAX features a touch-screen interface that guides the user through the steps needed to accomplish data acquisition and preliminary data analysis during data collection, or in review mode. Its hardware runs Windows® XP and includes signal conditioning for up to four channels of strain and four channels of acceleration, depending on the model (4-channel PE, 4- channel PR or 8-channel).

Upon power on, the PAX user is given access to the Windows Desktop where two versions of the PAX program are available. The user should select the preferred mode of operation, LOCAL (PDA-L - see page 7) or REMOTE (PDA-R - see page 57).

The LOCAL mode (PDA-L program) is intended for engineer operation on site. This mode of operation displays all results along with the measured signals on the PAX screen as the high strain test is being performed.

When running the PDA-R program, your PAX will work in Remote Mode. In this mode data is transmitted in real time to a remote computer running the PDA-W software. Data can be transmitted using high speed Internet through a broadband cell phone or any other kind of Internet connection, or using dial-up data transmission through a data capable mobile phone connected via USB.

When the PAX is running in Remote Mode, very little information is entered in the field. In most cases the field personnel will only attach the accelerometers and strain transducers on the foundation to be tested, connect them to the PAX and perform a few simple steps to achieve a connection and send data. A remote computer running the PDA-W software receives the data and gives the engineer the ability to perform comprehensive monitoring and analysis in real time.

In order to use the PAX in Remote Mode it is necessary to have the PDA-W program that was supplied with your unit installed on the remote computer. This manual contains information on how to set-up the communication parameters on the PDA-W program.

Both the PDA-L and PDA-R programs also allow the use of wireless connections for the sensors; in this kind of operation each strain transducer-accelerometer pair is connected to a transmitter unit, which is attached to the pile close to the sensors. The signals are captured by receivers built into the PAX, allowing reliable digital data transmission over more than 100 m (330 ft) distance, without the need of cables between the pile and the PAX unit.

# Tips for Getting Started

- Pile preparation involves drilling holes near the pile top (you must drill one hole for each accelerometer and two holes for each strain transducer). Refer to Appendix A (page A-3) for a detailed description of the pile preparation and sensor bolt arrangements required for various types of piles.

- Construction sites can be dangerous. Do not place your head and hands between the hammer and pile. Avoid standing near the hammer or pile while in operation and do not stand under any object being lifted. Falling objects can cause serious injuries. Plan an escape route before you need it. If you feel endangered stop what you are doing until the situation is corrected. Accidents can and do happen. Safety should always be your first priority.

- Make sure to know and comply with all safety rules and procedures specified for the jobsite.

- In bad weather (cold, rain, *etc.*), place the PAX in your car or other shelter. It is highly advisable to shade the PAX from direct sun. In extreme conditions, air conditioning or heating may be beneficial (see Specifications on page A-19 for operating and storage temperature range).

- Be sure all sensors, drills, bolts, and tools are with you at any test site. Assemble and test sensors and cables on the ground to avoid delays to the contractor.

- If sensors are to be attached a significant distance above ground, obtaining the assistance of the pile driving crew to attach sensors is highly recommended. If you must climb the leads, take precautions (use safety harness, wear gloves, etc.) to prevent serious injury. There are "sensor protectors" available from PDI which cover the sensors attached to the pile prior to lifting the pile, thus eliminating the need to climb the leads.

- The better you treat your equipment, the longer it will last. Do not drop the accelerometers. Do not step on strain transducers. Keep cables from being cut. Do not tie the cable to the leads if the pile is being driven, since the cables could be severed. Do not allow construction vehicles to run over your cables.

- Record site observations including hammer details, cushion description, date and time of testing (and of initial pile installation, and of static test if any), pile penetrations, etc. Make appropriate notes on a field worksheet. Record the rate of penetration of each pile tested, either by counting blows per unit penetration (i.e., per foot, inch, meter, etc.), or by directly measuring the set per blow by means of laser beam, topographic measurements or pencil marks using a fixed reference.

# Setting up the PAX


1 On-off switch (on newer models the rocker switch is inside the plastic casing)
2 Pilot lamp
3 12 Volt DC input
4 Blow count extension cord input
5 Piezoelectric (PE) main cable input
6 External monitor output
7 Network input
8 USB inputs (2)
9 Piezoresistive (PR) main cable input
10 Battery charger input
11 12 Volt DC output

To turn the unit on flip the toggle switch (1) on the side of the PAX. The pilot lamp (2) will illuminate. The PAX comes equipped with an internal battery good for a full day of operation. If the battery runs low, you can run the PAX connected to a 12 Volt car battery with the car power adapter connected to the 12 Volt input (3). The PAX also comes with an external power supply that connects to the mains supply (100 to 250 Volts AC, 50 to 60 Hz). The output of this power supply should be connected to the 12 Volt input (3). However, using a car battery instead of the external power supply is the recommended procedure in the field.

It is always recommended to fully charge the PAX the day before testing using the provided battery charger. To charge the PAX connect the charger to the Battery charger input (10). Full charge should take about 5 hours. A LED on the charger will indicate when charging is

complete. If your unit came with the Cell-Con charger, instructions can be found on the label on the bottom part of the charger. Usually an orange or red light means that charging is in process, and green light means that charging is complete.

NOTES:

1 **The PAX should always be turned off when charging the batteries**. Make sure the on/off toggle switch (1) is in the off position prior to charging. If it is left on while the battery charger is connected, the batteries may heat up and not be charged. If this happens just let the batteries cool off and charge them correctly. The PAX itself or the batteries should not get damaged.

2 The PAX uses two different external devices, one for providing the 12 Volts DC for its operation without using the internal batteries, and a separate one only for charging the batteries. Although the two devices look similar, their connectors are different so as to avoid any confusion.

Your PAX comes with Windows® XP and the PDA-L and PDA-R program already installed on it. To start either program, simply click on the PDA-L or PDA-R icon on the desktop.

Notes:

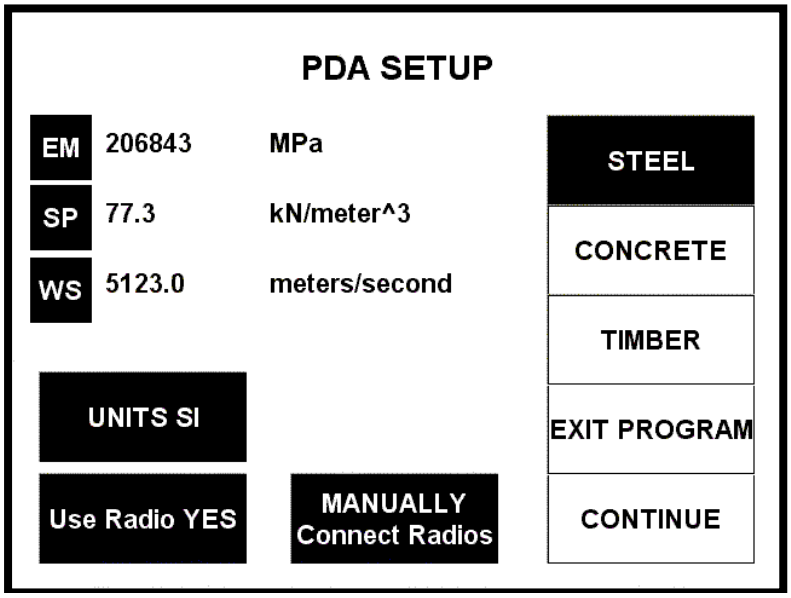
1. The PDA-L and PDA-R programs will not work on a normal notebook or desktop computer.
2. The PDA-L and PDA-R programs are not able to read data (W01 files) saved with the PDA-W program. However, the PDA-W program provided with your PAX will directly read the W01 files generated by the PDA-L or PDA-R.

The PAX comes equipped with 2 USB ports (8) for transferring data, connecting an external mouse or keyboard, etc. It also has a network (7) and external monitor (6) connections. A DE-9 to standard "RJ45" (8P8C) connector adapter is provided for network connections.

# PDA-L

# Condensed Setup Screen

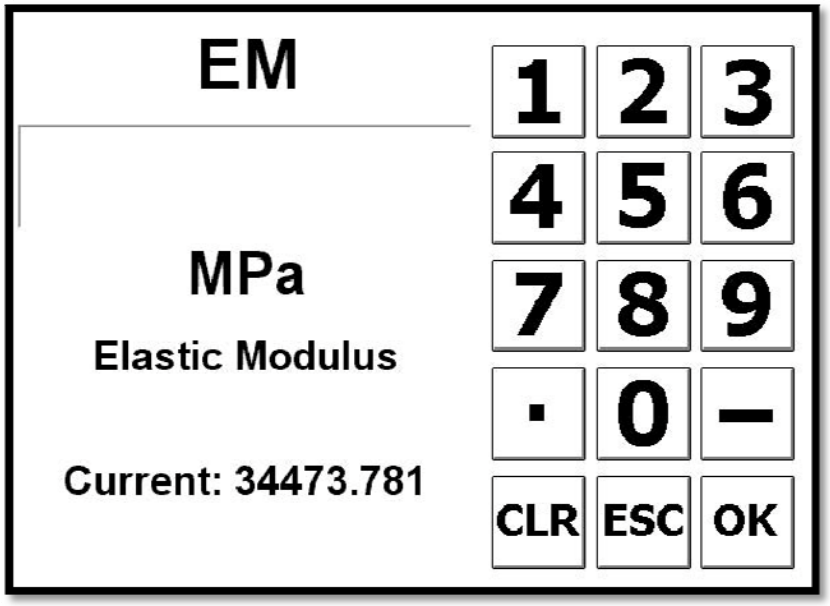
After exiting the Welcome Screen (by briefly touching it anywhere) you are taken to a Condensed Setup Screen (shown below).




Pressing the UNITS button will toggle through the available unit systems (SI, English, or Metric) and select the units that you will be working in. Next you should select the material of the pile: STEEL, CONCRETE or TIMBER. Note that for the selected material the default values for EM (Elastic Modulus), SP (Specific Weight) and WS (Wave Speed) will appear in the selected units.

The **Use Radio** and **Connect Radios** buttons refer to the wireless gages connection, which is covered on the corresponding chapter on page 47. If wireless gages are not being used (gages connected via main cable), the **Use Radio** button should be toggled to NO, and in this case the **Connect Radios** button will not be shown.

The default values for EM (Elastic Modulus), SP (Specific Weight) and WS (Wave Speed) may be changed by touching the corresponding button. For example, if you want to change the default elastic modulus for concrete in SI units (see note below), you would use the following screen:



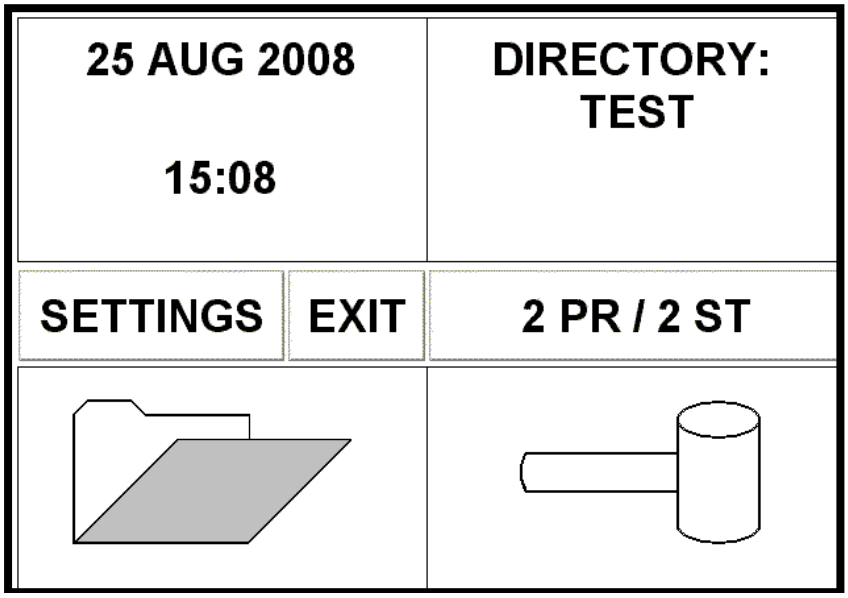

Just type in a new number and press OK. This number will be stored and used as the default value for the Elastic Modulus of concrete in SI units.

Notes:

- Changing one of the values (EM, SP or WS) will automatically adjust another one so that their relationship ($WS^2$ = EM x g/SP) is maintained.
- This information may also be changed before collecting new data using the Pile Tab.
- It is not recommended that the default values for steel be changed. However, the parameters for concrete and timber are more variable, and you might want to set them to values closer to those encountered in your usual practice.

Once you have made your selections and any desired changes you may hit CONTINUE to be taken to the Main Menu.

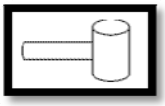
# Main Menu

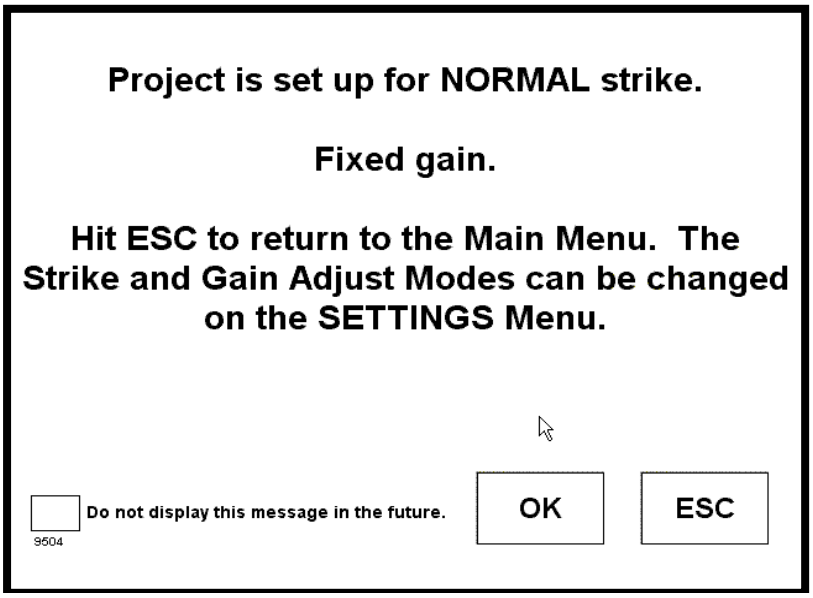



After clicking CONTINUE on the Condensed Setup Screen you will be taken to the Main Menu screen (shown above). Clicking on the upper left box, you will be allowed to edit the time and date. The upper right box will have the directory to which the files will be saved; clicking on the box will allow you to change the directory. The lower left box will take you to file review (see page 36 on retrieving and reviewing files). The lower right box will take you into collect mode (see page 12 on Collecting Data). On the middle bar, EXIT will exit the program, SETTINGS will take you into the settings menu (see page 38 for information on the settings), and 2 PR/2 ST will allow you to choose the number and type of sensors you will be using (in the picture above showing 2 Piezoresisive accelerometers plus 2 strain; other options would be 2 PE/2 ST and 2 PR/2 PE/4 ST – NOTE: currently if Wireless gages (Radio) are being used, this setting cannot be changed).

NOTE: touching the numbers that appear on the lower right corner of the Main Menu (not shown on the picture above) brings up an **"About"** screen. Please record and send the information contained on this screen when contacting PDI about your unit.

# Collecting Data - overview

Start collecting new data by touching the  button from the Main Menu. The following screen will then appear:



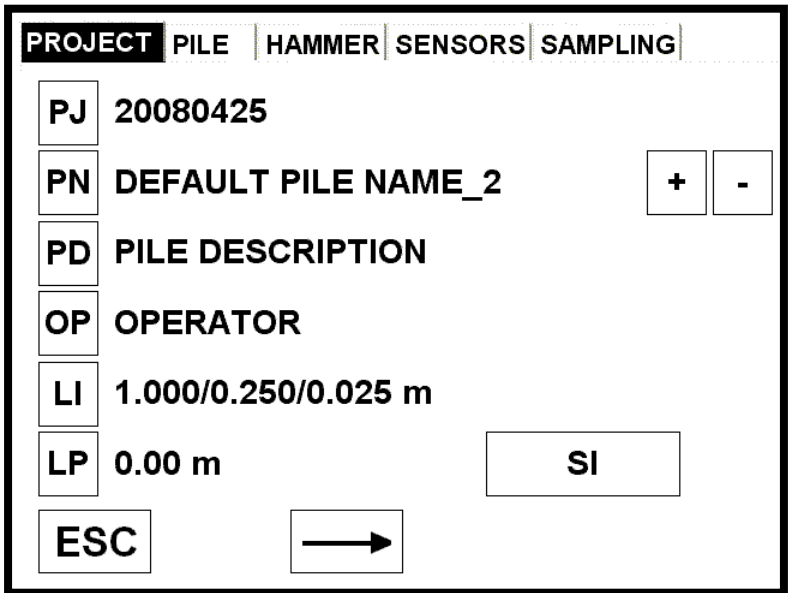

Smart gain adjusts the gain of each individual acceleration channel according to the maximum values of the previous blows. The initial gains are set according to the type of foundation material (Concrete, Steel or Timber) and the Normal or Restrike setting. This feature can improve the signal to noise ratio of signals with fairly constant amplitudes, but may not be adequate for recording blows with variable energy (like in drilled shaft testing, during Diesel hammers start-up, etc). The default is Fixed gain with Normal strike, which is adequate for most cases. This screen can be disabled on future start-ups by checking the box on the lower left side. See page 40 for instructions on how to turn this message back on.

If you want to change the Strike and/or the Gain Adjust Mode at this time touch ESC and choose SETTINGS (see page 38) on the Main Menu. If not touch on OK and you will be taken to the Pile Information Screen described on page 13. This screen has tabs for entering or checking Project, Pile, Hammer, Sensors and Sampling information. Touch the  button after going through all the tabs, and this will take you to the Balancing Gages Screen (see page 18). After making sure that all gages are balanced, touch *OK* to get to the Main Collect Screen (see page 20). When you enter the Collect Screen the unit will be Paused, that is, it will not accept new data. To start data collection press the  button at the left of the screen. The button will change to  . It is then advisable that you generate a Calibration Signal by

pressing the  button. You are then ready to start acquiring data. Start the hammer, and after each blow the signals captured by the sensors will be displayed on the upper right part of the screen, and the chosen results will be shown on the left part of the screen. By clicking on the buttons located on the two rows at the bottom of the screen you get access to additional functions that may be used before or during data collection (see page 20). When testing is complete press the DONE button to save the data. This takes you back to the Main Menu where the process can be started again for another data collection session. Note that the data will be saved in a file whose name is the same as the pile name, and with extension .W01. These files can be read directly by the PDA-W program. If a file with the same name already exists in the current folder, the program will automatically append _1, _2, etc to the file name. If necessary, files can be later merged together using the PDA-W program.

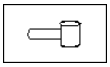
# Pile Information Screen

After pressing OK in response to the Project Setup message, or, if you choose to no longer see this message, directly after hitting the Hammer icon on the Main Menu, you will be taken to the PILE INFORMATION screen as shown below:




Changing tabs may be accomplished by touching the tab name at the top of the screen or by touching the arrow buttons at the right of the *ESC* button. The unit system (English, Metric or SI) may be changed by touching the button at the right side of the screen (showing SI in the example above).

• PROJECT tab See Page 14
• PILE tab See Page 14
• HAMMER tab See Page 14
• SENSORS tab See Page 15
• SAMPLING tab See Page 17

A  button is available only on the SENSORS and SAMPLING tabs. Touch this button when you are finished entering the input data. This will bring up the Balancing Gages screen (see page 18). It is strongly recommended that before touching this button you go through each of the tabs at the top of the screen, thus ensuring that all necessary data has been input.

## PROJECT Tab

This screen allows changing/viewing:

- PJ - Project Name (default is the Directory Name)
- PN - Pile Name (to increment or decrement the number touch on the **+** or **-** buttons on the right)
- PD - Pile Description (any optional text with additional information)
- OP - Operator Name (optional)
- LI - Length of Penetration Increment: amount in length units by which the penetration will be incremented each time LP+ (or the remote button) is touched during data collection. Two alternative increments are possible in English units (for example 1 ft and 0.08333 ft, or 1 inch), and three alternative increments are possible in Metric or SI units. NOTE: During data collection the second alternative increment may be edited using the keyboard (KB), and then entering LIXX, where XX is the new value.
- LP - Length of Penetration: pile penetration in the soil at the beginning of the test; this value will be incremented by LI during data collection.

## PILE Tab

This screen allows changing/viewing:

- AR - Cross-section area at the gages location. You may also use the area calculator (see page 43) by touching the *AR CALC (AREA)* button on the right hand side.
- LE - Length of foundation from the gages location to the toe.
- EM - Elastic Modulus of the foundation material at the gages location.
- SP - Specific weight of the foundation material at the gages location.
- WS - Wave speed. Note that WS is related to EM and SP. Therefore, changing any one of these values will automatically adjust another one so that their relationship ($WS^2$ = EM x g/SP) is maintained For example, if you change WS then EM will be recalculated, assuming that SP remains constant.
- JC - CASE damping factor that will be used for the calculation of RMX.

Touching the *STEEL*, *CONCRETE* or *TIMBER* buttons will replace EM, SP and WS with the default values for the corresponding type of material. These default values may be changed in the Condensed Setup Screen.

## HAMMER Tab

This screen allows the selection of the hammer being used for the test.

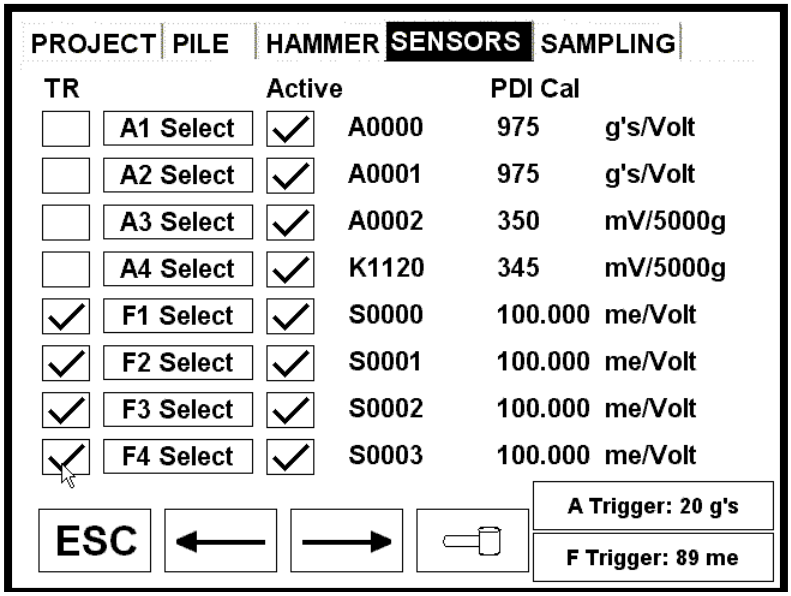
If you are using a custom hammer (for example a free fall hammer), touch the *CUSTOM HAMMER* box at the bottom right and enter the Maker, Name, Ram weight, Energy and Hammer Type, by touching the corresponding labels. Hammer Types may be Open End Diesel (OED), Closed End Diesel (CED), External Combustion (ECH - includes hydraulic, steam and free fall hammers), Hydro Block and Vibratory.

If you are using an industrialized hammer touch the *HAMMER FROM LIST* button at the bottom right, and browse the list for the particular hammer that you are using. You may filter the list by touching the *SELECT MAKER* button that now appears at the bottom right of the screen. After selecting the hammer and touching on *OK* the data will be transferred to the previous screen, but cannot be edited.

Touching the Max BPM label allows you to change the maximum blows per minute rate at which the PAX will be able to acquire data. If the hammer runs at a rate higher than the number specified here, some blows will not be recorded. The value entered should correspond to slightly higher than the maximum operating rate for the hammer. This will prevent the PAX from triggering on false blows due to hammer bounces, particularly when hydraulic or drop hammers are used.

## F/V Sensors Tab

Use this screen to set the calibration numbers of the transducers that you are using. The example below is for 8-channel operation:




Only the buttons corresponding to the active transducers according to the selection made in the Main Screen will be active. For example, if the selection shows 4 - PE, then only A1, A2, F1 and F2 will be active. Touching any of these buttons will open a new window showing a list of the stored transducers. If the one you are using is in the list, just highlight it and touch *OK*. If it is not, touch the *NEW* button and then enter the transducer ID number (usually engraved on the serial number plate or on the transducer itself), and sensitivity (which may be found in the calibration sheet provided by Pile Dynamics), then touch *OK* to store the new information.

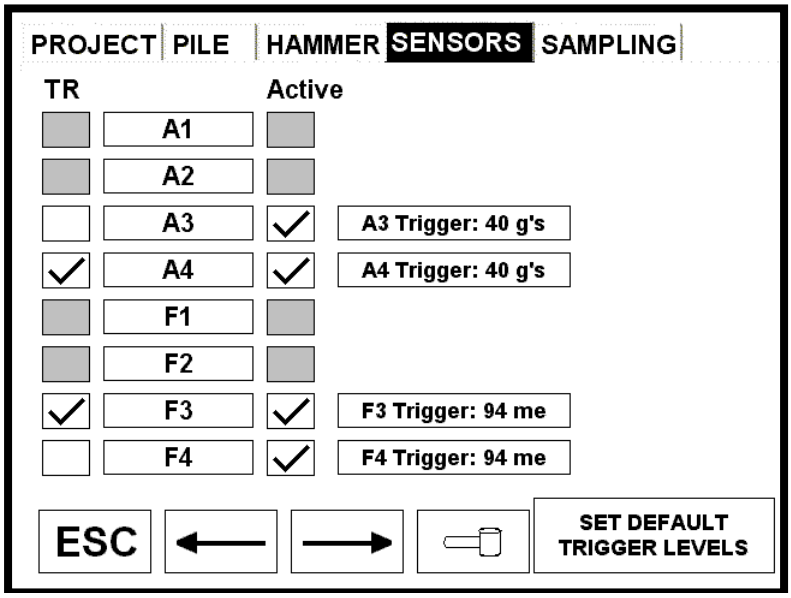
The TR column allows choosing which transducer will trigger the unit. The PAX will continually monitor this channel, until its voltage level exceeds a certain threshold. Only then will the unit start to acquire data. Note that only one acceleration but more than one force channel may be set as trigger at the same time. The Active column allows unselecting the channels that are not being used, so that it will not be averaged with the other acceleration or force signals. NOTE: it is recommended that at least one accelerometer and two strain transducers are used on all tests.

The *A Trigger* and *F Trigger* buttons are used for changing the trigger levels. In some cases these thresholds may be too high and the unit will not trigger, that is, it will not display any blow data upon a hammer impact, even though the unit is in Accept mode and everything seems to be in order. This can happen for example when applying low energy blows on extra cushioned systems, like concrete piles; it is a frequently encountered situation when testing cast-in-place piles, where the usual procedure is to start with a low drop height of a gravity hammer. In those cases the trigger threshold should be lowered, so the unit will react to the lower energy blows. If the threshold is set too low the unit may start to trigger on noise picked up by the gages, cables, etc. In this case the blow numbers will increase even though no hammer blow has been applied. Low numbers like 4 or even less for *A trigger* and *F trigger* have been successfully used, but the absolute lower limit depends on the individual case, and has to be determined by experience.

NOTES:

- Triggering on Acceleration is preferred to triggering on force, especially if wireless gages (radio) are being used (in this case the aligning of acceleration data will be easier and likely result in more consistent triggers, particularly for diesel hammers).
- If triggering on force, it is advisable to trigger on all available force channels. Note that in case of extreme bending one force might be very low (and even negative) and result in no triggering at all on one channel while the accelerations will still be similar.
- The PAX will issue temporary warning messages after staying for a long time in Accept mode without receiving any signal.

When Wireless Gages (Radio) are being used, this screen will look a little different:



These are the main differences when using Wireless Gages:

- The trigger levels can be set independently for each sensor
- It is not possible to enter the serial numbers and calibration factors for the sensors. If smart gages are being used, this information will be entered automatically. If regular gages are being used, this information will have to be entered later on the collect screen.
- Each transmitter needs to have one trigger channel. In the example above, one transmitter is triggering on the acceleration signal (A4), and the other on the force signal (F3). Any combination is possible.
- The *SET DEFAULT TRIGGER LEVELS* button is available. Touch it to return all trigger levels to the factory settings.

## SAMPLING Tab

This section allows choosing the sampling frequency and the number of samples stored for each blow. The analog signals are converted to digital information at a rate defined by the Sample Frequency. A total of either 1024, 2048 or 4096 samples may be stored for each signal, as selected under Sample Size. The total time that will be stored is shown in the highlighted box under the Sample Frequency buttons and is a function of the Sample Frequency and of the Sample Rate. For example, if 2048 samples are stored at a frequency of 10000 Hz, then a total of 2048 x 1/10000 seconds or 204.8 milliseconds will be stored. Actually, this is the recommended setting for most applications.

The available sampling frequencies depend on the sampling size. The table below shows the available sampling sizes and frequencies, and the corresponding total record durations.

| Sampling Size | Record duration (ms) for frequencies (Hz) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 40000 | 20000 | 10000 | 6667 | 5000 | 4000 | 3333 | 2500 |
| 1024 | 25.6 | 51.2 | 102.4 | 153.6 | 204.8 | 256.0 | 307.2 | 409.6 |
| 2048 | 51.2 | 102.4 | **204.8** | 307.2 | 409.6 | 512.0 | 614.4 | 819.2 |
| 4096 | 102.4 | 204.8 | 409.6 | 614.4 | 819.2 | 1024.0 | 1228.8 | 1638.4 |

Note:

- Some combinations are available only for vibratory hammers.

Note that the recommended total record duration of 204.8 ms may also be achieved with other combinations of sampling size and frequency. The resulting file size will be larger for larger sampling sizes. Higher sampling frequencies are recommended for steel to steel impact, like with SPT rods or certain types of hammers that use no cushioning between hammer and helmet.

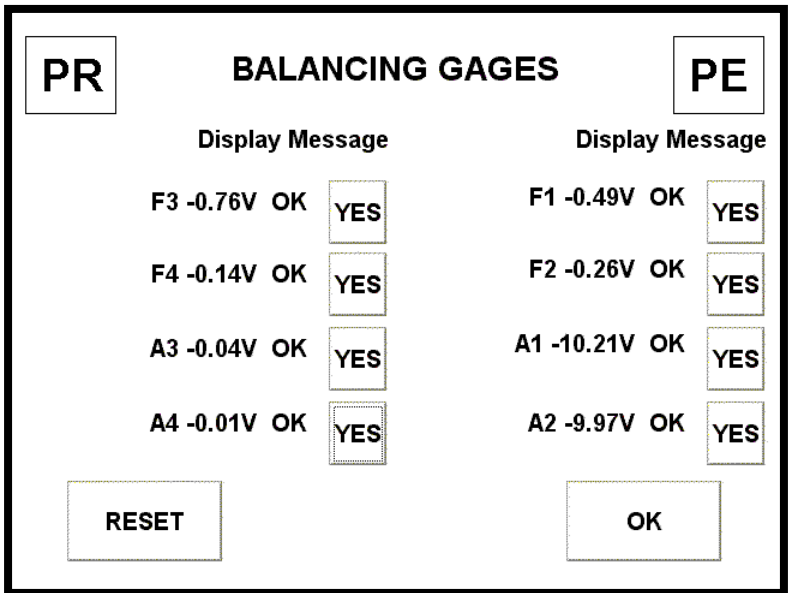
The Pretrigger Buffer Time specifies the amount of data that will be recorded, corresponding to the information detected by the sensors just prior to triggering. The Pretrigger Buffer Time is fixed for non-diesel hammers. For diesel hammers it defaults to a value which is a function of sample size and frequency and the particular hammer chosen in the Hammer Tab, but it may be changed by touching the corresponding box at the top right of the screen. The Pretrigger Buffer Time cannot be lower than the default value, and may be reset to the default value by touching the box saying *time fixed for non-diesel hammers*.

When using Wireless Gages (Radio, see page 47), the number of Sample Frequency options is reduced, and another field called *Extra Data Align Samples* appears on the screen. This allows

the user to change the number of extra samples which will be added to the number selected under *Sampling Size*. This is necessary for aligning the two force and/or the two velocity signals, when wireless signal transmission is used. The default 10% is sufficient for most cases (for example, with a selected Sampling Size of 2048, the actual number of samples will be 2253). The *Estimated thruput* is also provided as information. This corresponds to the maximum number of blows per minute that the PAX will be able to receive without skipping any blow, and is a function of sample size and frequency.

# Balancing Gages

Prior to acquiring data, you should first check the sensor offsets. The Balancing Gages screen appears when starting to acquire new data, or during data collection by clicking the OF button (see page 32). The picture below shows the Balancing Gages screen for 8-channel operation (four strain transducers, two PE accelerometers and two PR accelerometers):



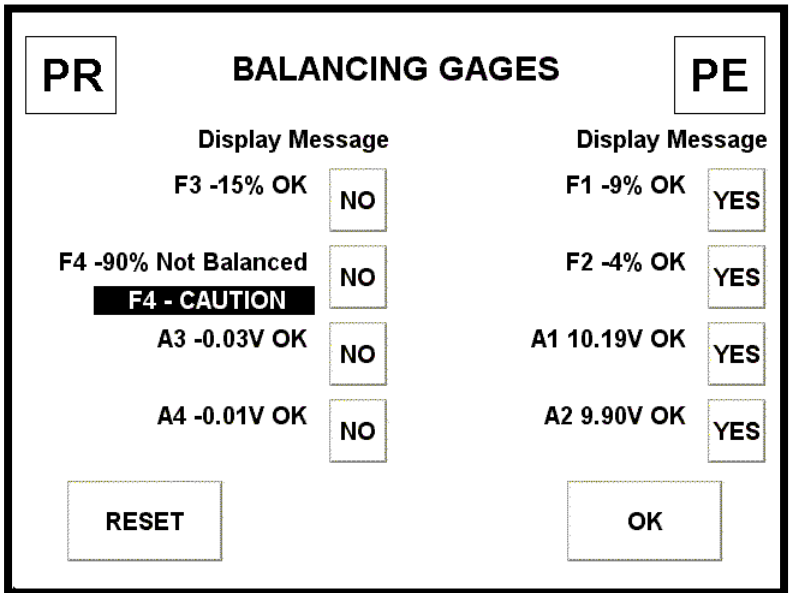

If only PE accelerometers are used, the information for F3, F4, A3 and A4 will not be shown, and the PR button at the upper left side of the screen will be crossed out. If only PR accelerometers are used, then the information for F1, F2, A1 and A2 will not be shown, and the PE button will be crossed out.

After a few seconds, all sensors should show "OK". Any message of "Not Balanced" may mean a problem with the corresponding sensor and/or cable. For the strain gages, if you get a "Not Balanced" message you should try to correct by loosening that sensor and adjusting (stretching or compressing the sensor) prior to data collection to prevent "clipped signals" in the A/D process which make the data useless. Negative values indicate the sensor is currently in a tension condition; positive values indicate the sensor is in a compression condition. The main cause of bad offsets in strain gages is either non-flat mounting surfaces or incorrect spacing between the holes (3 inch or 76 mm). It is imperative that the hole spacing be correct for the strain sensors to function properly. Use a drilling template on concrete piles.

The balancer output voltage displayed on the right of each sensor name is for information and servicing purposes only. The acceptable ranges are as follows:

- For Force it displays the percent (positive or negative) of balancing range that is necessary to balance the gage; if this number is greater/less than +/- 70% a reverse image caution will be displayed below the % line.
- For PE accelerometers the offset will be displayed as a positive voltage; if the offset is outside of the range 8 to 16 volts a reverse image caution will be displayed below the offset number.
- For PR accelerometers the gage offset will be displayed in volts (positive or negative); if this number is greater than 0.060 volts or smaller than -0.060 volts a caution will be displayed in reverse image below the offset value.

The picture below shows an example of the BALANCING GAGES screen, with F4 not connected. Note that the **F4 - CAUTION** message in this case will not show up on the collect screen, since the corresponding button on the *Display Message* column is set to NO.

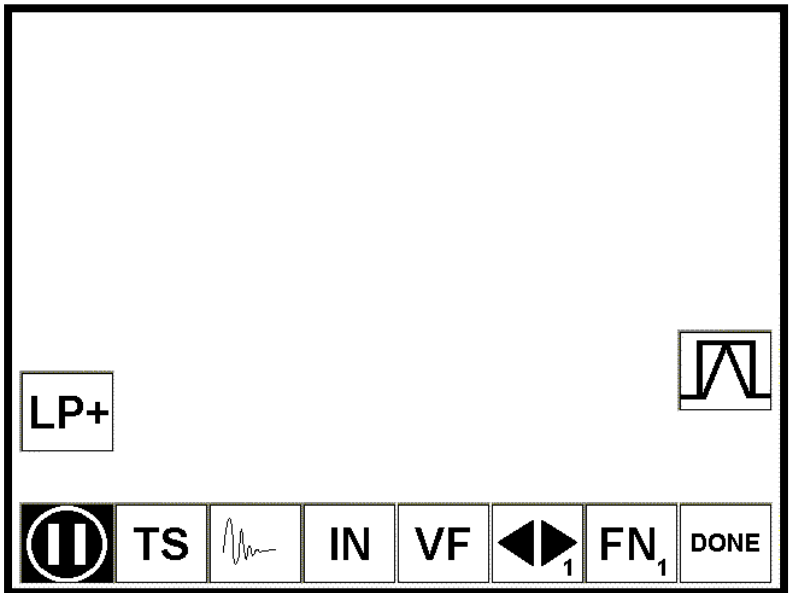



The RESET button will reinitialize the input circuit board. It should be used only on the rare cases when the gages will not balance, even though all the sensors, cables and connections seem to be in good condition.

After gages are balanced properly, touch *OK* to be taken to the MAIN COLLECT Screen (next page).

# Main Collect Screen

After pressing *OK* on the Balancing Gages Screen you will be taken to the Main Collect Screen, which looks as shown below:




The  button indicates that the PAX is in standby; by pressing the button, it will change to a  and the PAX will begin to record data. When testing is complete, the DONE button should be pressed to save the data and initiate a new testing session.

The bottom row of buttons selects the various functions that are available during and after testing. Pressing any of the buttons on the bottom row will make another row of buttons to appear above it, showing the various functions options. These functions are as follows and more information on them can be found on the following pages:

- Time Scale Page 23
- Display Mode Page 24
- Input Parameters Page 28
- Sensor Properties Page 29
- Browsing Saved Data Page 30
- Special Functions Page 32

Note: The top row will disappear:

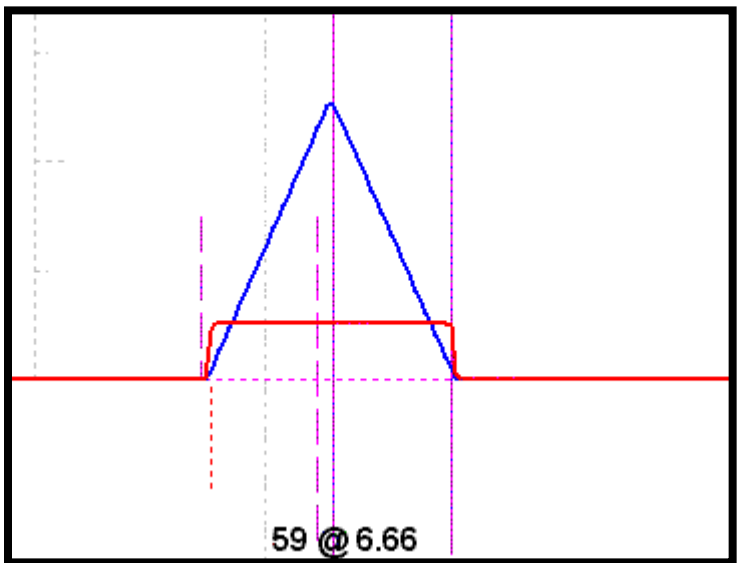
1. After a set amount of time. The default amount of time that the top row appears is 5 seconds. To change the time, select MENU TIME from the FN3 menu.
2. When you touch the center of the screen.
3. When you hit the minimize button 

To change the displayed quantities that appear on the upper left part of the screen, simply touch that area and you can edit and change the displayed quantities (see page 22).

## Collecting Data

To start collecting data, first touch the  button on the left side of the screen, so that it now shows the  button, this will put you into accept mode and will be able to start collecting data.

You should first generate a calibration signal by pressing the flashing  button on the right side on the screen. You should see a signal similar to the picture below:




NOTE: The actual image probably will not look exactly the same because of different scale settings.

The vertical scales can be adjusted by touching the  button and the horizontal scale by touching the 

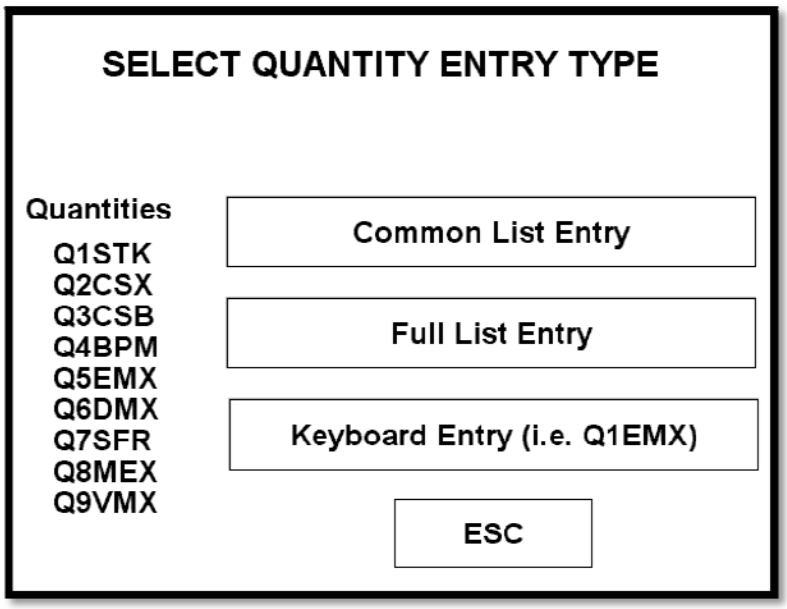
button (see page 23 for more information on adjusting the vertical and horizontal scale). The line colors and styles can be changed by touching *SETTINGS* on the Main Menu, and then choosing *GRAPH SETUP* (see page 38 for more information).

If using Piezoelectric accelerometers, the bottom part of the screen will then say "Calibration requires a 15 second wait - Time remaining before data collection resumes XX seconds". After the countdown reaches zero and your settings are as desired, you can start applying the blows and recording data.

Once the test is completed, click on the *DONE* button to save the data and go back to the MAIN MENU; repeat the same steps for the other piles to be tested.

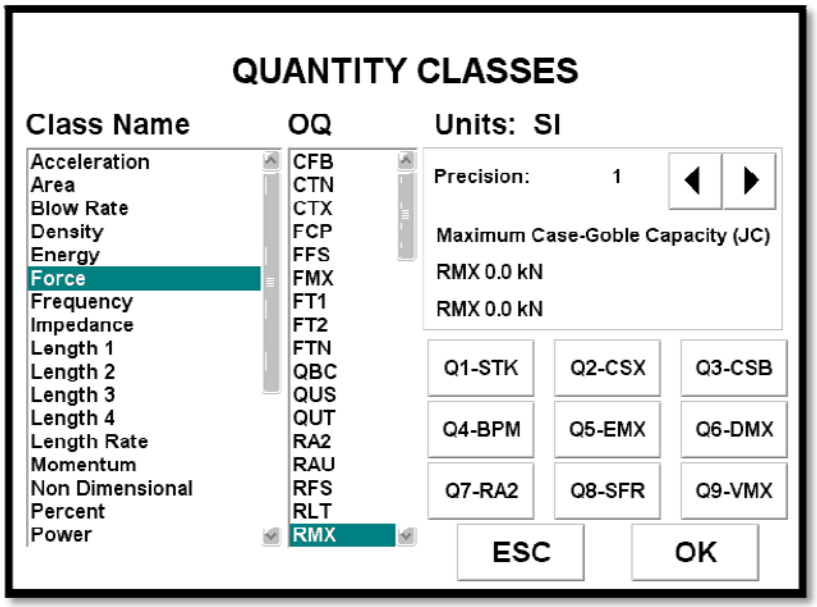
# Changing Quantities (Q1...Q9)

During data collection or data review mode, touching the top left part of the screen where the nine quantities are displayed will show the following screen:




Touching *Common List Entry* will display a list of pre-selected quantities, according to the type of hammer selected. The user still has some choices available for quantities Q3, Q6, Q7, Q8 and Q9. Touching *Set Precision* from this screen will bring up the *Quantity Classes* screen shown next.

Touching *Full List Entry* will show a screen like the one below:

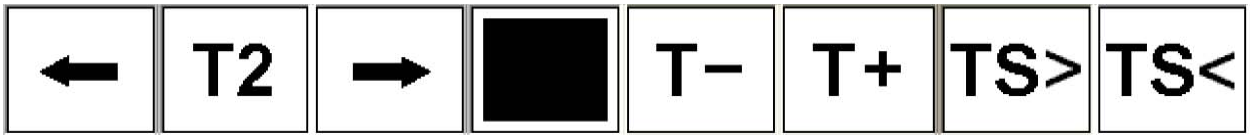


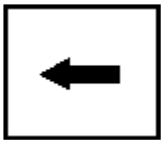
Select the type of the quantity in the *Class Name* column and then select the particular quantity in the *OQ* column. Touching any of the buttons on the right side of the screen will change the corresponding quantity to the one selected. In the example shown above, touching the *Q1-STK* button will change Q1 to RMX. You can also change the precision (i.e., the number of decimal digits) of all quantities in that class by touching the left or right arrow at the top right of the screen.

Touching *Keyboard Entry* will open a keyboard-like screen which allows the direct entry of the quantities. For example, typing Q1EMX and then OK will set Q1 to EMX.

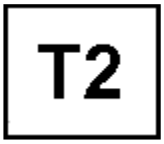
## Adjusting Time Scale (TS)

Touch the TS button on the row of buttons underneath the graph, and an additional row of buttons will then appear like this:

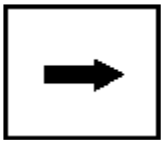


Shifts the vertical line T1 and/or T2 to the left, according to selection made on the button to the right.



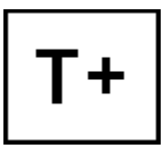

Toggles the line selection from T1 to T2 to T1/2. This affects the behavior of the left and right arrows. When only T2 is selected, WC is also adjusted when the line is moved with the arrows.



Shifts the vertical line T1 and/or T2 to the right, according to selection made on the button to the left.

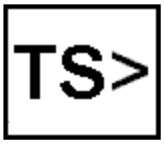
Toggles between small and large shifts when touching the left or right arrows.


Shifts the whole curve left by increasing TB (Time of Beginning).




Shifts the whole curve right by decreasing TB (Time of Beginning).


Decreases time scale TS (expands graph horizontally).




Increases time scale TS (contracts graph horizontally

## Changing Display Mode

This is accomplished by touching the  button on the first row of buttons underneath the graph. An additional row of buttons will then appear like this (or slightly different if D,E is being displayed, see note on page 27):


Scale automatically adjusted to give generally acceptable and normal force signals (Autoscale).

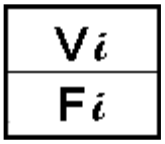
Decrease scale (expand graph vertically).

Increase scale (contract graph vertically).


Display Individual Forces on top and Individual Velocities on bottom.


Display Average Force and Average Velocity on top, Wave Up and Displacement on bottom.


Display Average Force and Average Velocity (upper part of button) or Wave Down and Wave Up (lower part of button). Note: in this example the FV button is shown in reverse video since this is being displayed.




Display Average Force and Velocity on top, and on bottom either Individual Velocities (upper part of button) or Individual Forces (lower part of button).


Brings up the Display Type Menu described next

This is a list of display options available on the Display Type Menu. These options can also be accessed by using the KB function of FN1 (see page 32), and entering the shortcut codes listed below. The options in bold letters are the ones most frequently used.

| Display Type | Shortcut | Description |
|---|---|---|
| **Force and Velocity** | **DPF** | **Average force (F) and average velocity (V)** |
| Wave Down and Wave Up | DPW | Wave Down = (F+ZV)/2 and Wave Up = (F-ZV)/2 |
| Resistance | DPR | RSP (CASE Method Capacity for selected JC) and RTL (CASE Method Capacity for JC=0) versus time |
| Energy and Displacement | DPE | Average force (F) and average velocity (V) |
| | | Transferred energy (from integral of FV) and pile top displacement (from integral of V) versus time |
| Energy (FV and F^2) and Displacement | DPE2 | Average force (F) and average velocity (V) |
| | | Transferred energy from integral of FV (E), transferred energy from integral of $F^2$ (EF2) and pile top displacement from integral of V (D) |
| **Force/Velocity/Wave Up/Displacement** | **DPFW** | **Average force (F) and average velocity (V)** |
| | | **Wave Up = (F+ZV)/2 and pile top displacement from integral of V (D)** |
| Force/Velocity/Wave Up/Wave Down | DPWF | Average force (F) and average velocity (V) |
| | | Wave Down = (F+ZV)/2 and Wave Up = (F-ZV)/2 |
| Average Force, F1, F2 | DPS | Average force (F) and average velocity (V) |

| Display Type | Shortcut | Description |
|---|---|---|
| | | Individual force signals (F1, F2 and/or F3, F4) |
| Average Velocity, V1, V2 | DPV | Average force (F) and average velocity (V) |
| | | Individual velocity signals (V1, V2 and/or V3, V4) |
| Force/Velocity, RS, RT | DPFR | Average force (F) and average velocity (V) |
| | | RSP (CASE Method Capacity for selected JC) and RTL (CASE Method Capacity for JC=0) versus time |
| Individual Velocity Displacement | DPD | Average force (F) , V1 (or V3) and top displacement from the integral of V1 (or V3) |
| | | Average force (F), V2 (or V4) and top displacement from the integral of V2 (or V4) |
| **Individual Force/Velocity** | **DPFV** | **Individual force signals (F1, F2 and/or F3, F4)** |
| | | **Individual velocity signals (V1, V2 and/or V3, V4)** |
| Acceleration and Strain | DSA | Average acceleration (A) and average strain (S) |
| Acceleration/Strain | DAS | Individual accelerations (A1, A2 and/or A3, A4) |
| | | Individual strains (S1, S2 and/or S3, S4) |
| Average A, A1, A2 | DASA | Average acceleration (A) |
| | | Individual accelerations (A1, A2 and/or A3, A4) |
| Average S, S1, S2 | DASS | Average strain (S) |
| | | Individual strains (S1, S2 and/or S3, S4) |
| Acceleration/Velocity | DAV | Individual accelerations (A1, A2 and/or A3, A4) |
| | | Individual velocities (V1, V2 and/or V3, V4) |
| Velocity/Wave Down/Acceleration | DPVA | Average velocity (V), average acceleration (A) and Wave Down = (F+ZV)/2 |
| Force/Velocity/BETA Processing | DPBP | Average force (F) and average velocity (V) |
| | | BETA processing: allows adjusting the limits and shifting the time periods of BETA detection. The AREA adjustment defines a time after T1 where the steep rise of wave-up has finished. Since small shifts between |

| Display Type | Shortcut | Description |
|---|---|---|
| | | force and velocity (phase shifts) can cause false indications of damage in this part of the record, a value of 100% is shown for BETA values above MAX BTA 1. In the later part of the record the BETA detection is less sensitive to phase shifts, so MAX BTA 2 can be set to a higher value. The default settings can be restored by clicking the corresponding button. |
| Force/Velocity/BETA Damage | DPBD | Average force (F) and average velocity (V) |
| | | Shows a graphical representation of the pile indicating the location of the BETA. The value displayed can be changed from BETA to LTD (distance from gages to damage location), by touching the buttons on the right |
| Force/Velocity, Resistance Distribution | DPRU | Average force (F) and average velocity (V) |
| | | Shows a crude approximation of the location of resistance along the shaft, and breakdown between shaft and toe. BETA indications can be switched on or off by touching the check box at the right |
| Force/Velocity/Tension Envelope | DPTE | Average force (F) and average velocity (V) |
| | | Shows the tension stresses as a function of pile length. The maximum tension for first 2L/c (TSN) and the tension (TLS) at the LS (Length to Splice) location are displayed. LS can be set by using the corresponding button after pressing IN2, or by using the KB function after pressing FN1 and typing LSXX, where XX is the distance between the sensors and the splice. TLS is useful in assessing the tension at a specific pile location. |

Note:

- The upper row of buttons may display buttons for increasing or decreasing the Displacement or Energy scales, when those quantities are selected. In this case the  button will show a 1 or 2 on its lower right side. Press the button to toggle between the two states; this will change the upper row of buttons so that additional options are available.

# Changing Input Parameters (IN)

This is accomplished by touching the IN1 or the IN2 button on the row of buttons underneath the graph (touch the button again to toggle from one to the other). An additional row of buttons will then appear like this for IN1:


Or like this for IN2: 

(Only two buttons)

Edit/View Elastic Modulus.

Edit/View Specific Weight.

Edit/View Wave Speed.

Edit/View Length of Penetration.

Edit/View Cross Section Area (Area Calculator page 43).

Edit/View Length below gages.

Toggle Length Increment.

Increase Length of Penetration by the Length Increment

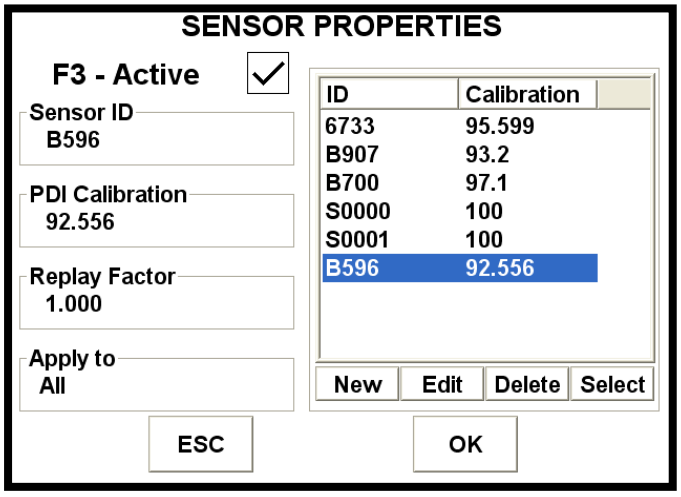
| | |
|---|---|
| JC | Case Method JC factor |
| LS | Length to Splice – enter the length between the sensors and the splice. A vertical line will appear on the graph at this location. This is also the location where TLS (tension stress at splice) will be calculated. |

## Adjusting Sensor Properties

Touching the VF1 button will activate an additional row of buttons like the one below (shown here for 8-channel mode):

| V1 | V2 | V3 | V4 | F1 | F2 | F3 | F4 |
|---|---|---|---|---|---|---|---|
| A0000 | A0001 | A0002 | A0003 | S0000 | S0001 | S0002 | S0003 |
| 975 | 975 | 350 | 350 | 100.00 | 100.00 | 100.00 | 100.00 |

For example, A0000 on the V1 button indicates its serial number, and 975 indicates its calibration number (sensitivity). Some buttons may not be present depending on the number of gages selected on the Main Menu. Touching any of the above buttons will open up the Sensor Properties Window. Below is an example of a screen for F3 with three digit precision (see page 38 for instructions on how to change the CALIBRATION PRECISION, that is, the number of decimals shown on the calibration numbers).



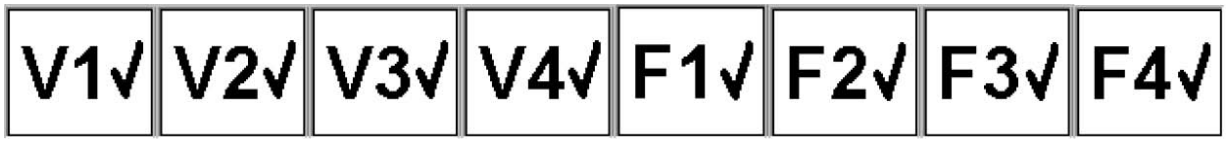

This screen allows the direct input of the gage ID and Calibration Factor. It is also possible to select a gage from the list on the right hand side of the screen, and also edit the list by touching the appropriate button (*New*, *Edit*, *Delete* or *Select*).

The *Replay Factor* may also be changed for the corresponding signal. Replay Factors adjust the magnitude of the sensor output. In general, there should be no reason to do this for good data and proper entry of parameters. Thus, a Replay Factor of 1.00 is the default and is desirable. Changing to any other factor may not be justified. One example of the possible need for changing the Replay Factor is when an accelerometer is not axially aligned with the foundation shaft and its signal is then reduced by the cosine of the angle. The signal may be increased to restore the correct magnitude by entry of the inverse of the cosine into the replay factor.

The "Apply to" box only appears in Review Mode, and allows toggling between All, Current to End, 1st to Current and Current Only. The changes will be applied only to the specified group of records.

The corresponding sensor active status may be changed by touching the box at the top of the screen. This may be more easily accomplished using the procedure described next.

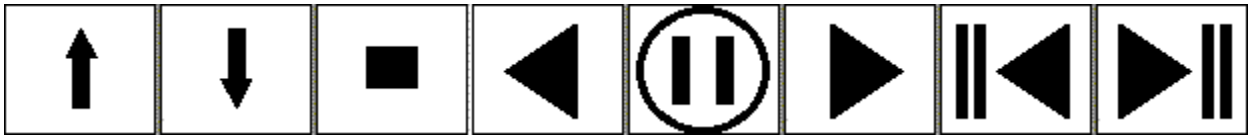
Touching  a second time will make it change to  (Sensor On/Off Mode), and the upper row of buttons will look like this:




Some buttons may not be present depending on the number of gages selected in the Main Screen. Touching any button will toggle the sensor On or Off. The buttons as shown above indicate that all sensors are ON. If for instance V1 is turned OFF the corresponding button will look like this:

## Browsing Saved Data

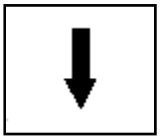
This function is accessed by touching the  button. An additional row of buttons will then appear like this:

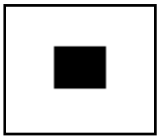


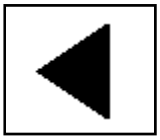
Touching the button  again will make the number at the bottom right change to 2, and the upper row of buttons will then look like this:

(Two buttons only)

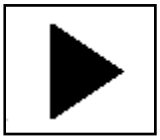

Move to next record.

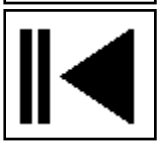

Move to previous record.


Small square = show every record
Medium square = show every third record
Big square = show every sixth record.


Auto replay backwards.


Pause auto replay.


Auto replay forward.


Jump to first record.


Jump to last record.


Set replay timer for auto replay.

Jump to Save Location.

## Special Functions (FN)

Touching the FN1 button once will make an additional row of buttons appear like this:


Touching the button FN1 again will change it to FN2 and the additional row of buttons will then look like this:


Touching the FN2 one more time will change it to FN3 and the additional row of buttons will look like this:

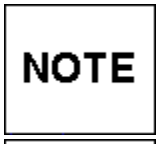
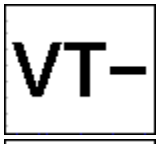
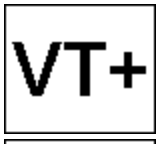

If radio (wireless gages) is being used, a fourth option FN4 is available, which will bring up the following row of buttons:

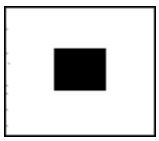
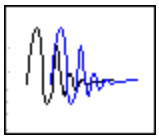


Opens a Keyboard so that commands may be entered with two-letter commands (see Page 44), or display options can be chosen using shortcut codes (see page 25)


Applies a smoothing to the velocity curves. VF1 means no filter is applied. See page 45


Applies a smoothing to the force and velocity curves. FF1 means no filter is applied. See page 45

| | |
|---|---|
|   | Switches WC editing mode from Constant (con) to Individual Blow by Blow (ind) to Blow by Blow Auto (auto). See page 45 |
|   | Resets the Delay Time back to zero, that is, brings T1 and T2 back to their original default position. |
|   | Shows a screen that allows viewing or changing the trigger channel(s) and levels. |
|   | Allows manual adjust of the Time of Beginning. See also Time Scale (TS). |
|   | Allows adding a Note (Comment) to the current record. |
|   | Shifts the velocity signal left (force signal remains fixed) by a fixed distance each time it is pressed. |
|   | Shifts the velocity signal right (force signal remains fixed) by a fixed distance each time it is pressed. |
|   | Velocity Auto Shift Resolution - adjusts how big each shift to the right or left will be when pressing VT- or VT+. |
|   | Allows manual input of velocity time shift – overrides VT- and VT+ |
|   | Sets the sample number where the velocity is adjusted to zero. |
|   | Decreases VE by an increment defined by the "square" button. |
|   | Increases VE by an increment defined by the "square" button. |

| | |
|---|---|
|  | Defines a small, medium or big increment for VN and VP. |
| OF | Checks the gages offset. See page 18 |
|  | Generates a calibration signal. |
|  | Battery indicator – see notes at the bottom of this page |
| MENU TIME | Sets the amount of time that the additional row of buttons stays on the screen after one of the buttons on the bottom row is pressed. |
|  | Radio Align (available only if Wireless gages are being used – see page 53) |
| RESET RADIOS | Reset Radios (available only if Wireless gages are being used – see page 55) |
| CALIB | Forces the radios to reread the "smart sensor" ids and calibration values. Use for example after replacing sensors during a test. |
| RADIO | Displays the Radio Communication data (available only if Wireless gages are being used – see page 55) |
| HELP | Opens the on-line help |
|  | PDI Logo (no function). |

Notes on the battery indicator:

- The PAX continuously monitors the status of its internal battery, and it also continuously receives information on the status of the radio transmitter batteries. If the charge on any of those batteries drops to unsafe levels, a message will pop up on the screen. The

message can be dismissed by the user, but will appear again after a preset amount of time.

- If a message saying "BATTERY IS LOW – Connect power supply to avert automatic shutdown – Charge overnight before field use" comes up, you should immediately connect the PAX to a car battery, using the adapter provided for that purpose (see page 5).
- If a message "BATTERY IS LOW ON RADIO XX" comes up, you should stop the test as soon as possible and either recharge the transmitter or replace it with a fully charged one.
- When pressed, the battery indicator button will show a screen describing the status of all batteries (PAX internal and radio transmitters). However, it will not indicate how much time there is still left of charge. The warning messages will start to pop up when there is about 30 minutes or less of battery power remaining.
- IMPORTANT: The Power Options settings on Windows Control Panel must not be changed. Some "Power Save" options are incompatible with the PDA-L and PDA-R programs.

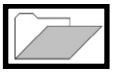
# Warning Messages

Messages like the ones shown below may appear on the upper right part of the Collect Screen (or Review Data Screen when in Review Mode).

| | |
|---|---|
| CSB | Indicates that the Computed Stress at Bottom is above the limit set at the Stress Limits Screen. See page 42 for instructions on how to change this limit. |
| CSX | Indicates that the Maximum Average Compressive Stress is above the upper limit or below the lower limit set at the Stress Limits Screen. See page 42 for instructions on how to change those limits. |
| TSX | Indicates that the Maximum Calculated Tension Stress is above the limit set at the Stress Limits Screen. See page 42 for instructions on how to change this limit. |
| F/F | Indicates that the ratio of measured strains at time T1 is higher than 4/3 or lower than 3/4. In most cases this indicates only that bending exists at the measurement location of the pile due to eccentricity or misalignment of the hammer or driving system, and therefore realignment is recommended. You can proceed with the test if proportionality and the non-uniform stresses (CSI) are still acceptable. Please note, however, that there might be higher stresses in the axes other than the measurement axis. |
| V/V | Indicates that the ratio of measured velocities at time T1 is higher than 5/4 or lower than 4/5. In most cases this means that there is a problem with one of the accelerometers or its wiring, since the velocity signals should all be very similar. You should immediately change the display mode so that it shows the individual velocities (see page 24), in order to identify and switch off the bad velocity signal. At the first opportunity you should reattach or replace the accelerometer, or check the cables. |

| | |
|---|---|
| F | Indicates that clipping was detected in at least one of the force signals. You should immediately change the display mode so that it shows the individual forces (see page 24), and check if one of the force signals has the top or bottom part clipped. See page A-15 for an example of a clipped signal, and for remedial actions. IMPORTANT: records with clipped force signal must be discarded, as all CASE method and CAPWAP results will be wrong. |
| A | Indicates that clipping was detected in at least one of the acceleration signals. In most cases this means that there is a problem with that accelerometer or its wiring. You should immediately change the display mode (see page 24) so that it shows the individual velocities, which should be very similar. This will allow you to identify and switch off the bad velocity signal. At the first opportunity you should reattach or replace the accelerometer, or check the cables. |
| F/V | Indicates that the ratio of force and velocity times impedance at time T1 (FVP) is above $^4/_3$ or below ¾. This might be an indication that the signal is not proportional. See page A-15 for possible causes. |
| BTA | Indicates that a BETA less than 100% has been detected. The location of the possible defect is shown as a vertical line on the graph, together with the BETA value and distance below gages (example: 79 @ 3.5 means a BETA of 79% has been detected 3.5 length units below the gages). Use the BETA processing screen described on page 26 for changing the behavior of the BETA indicator. |
| CL | Indicates that the capacity is lower than the value set in the TARGET CAPACITY screen |

# Reviewing Stored Data

You may see a list of previously saved data by touching the  button from the Main Screen. You may sort the list by Pile (file) Name, Date, Size or Directory (folder), by touching the corresponding column heading. Touching any file name will highlight it, then touching the Select File button will show a screen with the file name at the top, and buttons that allow you to *Review*, *Delete* or *Rename* the file. Pressing Escape at any time on these screens will return to the previous one.

NOTE: The button *Combine Records* should be used only in rare cases using wireless gages (radio), when due to synchronization problems sometimes the two force-velocity pairs are stored as different blows, although with the same date-time stamp. This function combines the two separate records into one single record, thus allowing the file to be used normally.

Touching the **Review** button will take you to the Review Data Screen, which, similarly to the Collect Screen, will display the signals on the right side and the foundation data and calculated quantities on the left side.

Several viewing and editing functions are available by touching the row of buttons at the bottom of the screen (most of these functions are similar to the ones available on the Collect Screen):

- Adjust File Size (W-) (see page 37)
- Time Scale (TS) (same as on Collect Screen – see page 23)
- Display Mode (same as on Collect Screen – see page 24)

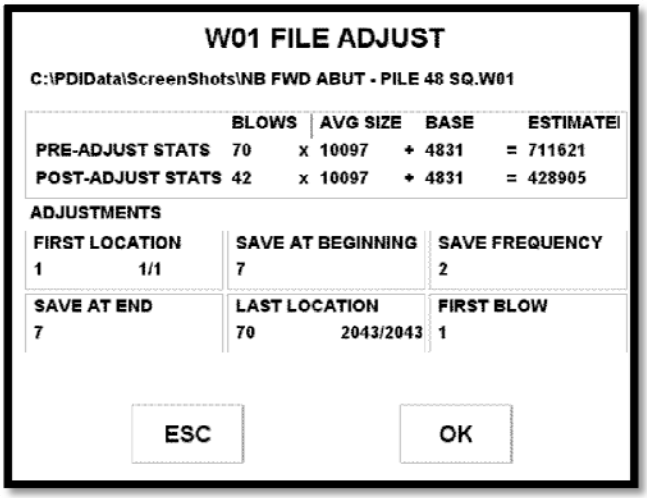
- Input Parameters (IN) (same as on Collect Screen – see page 28)
- Sensor Properties (VF) (same as on Collect Screen – see page 29)
- Browsing Data (same as on Collect Screen – see Page 30)
- Special functions FN1, FN2 and FN3 - similar to Collect Screen (see page 32), except:
    - Create a Bitmap File (BMP), which replaces the TR button on FN1 - touch it to save a bitmap copy of the screen onto the project folder (the file names will be automatically set by the program).

When reviewing data collected using the Wireless Gages FN3 will also show the Radio Align button (see page 53).

The files may also be backed up to an external memory source via the USB ports on the back of the PAX. To do this you will need to exit the program and use the Windows file explorer to locate and transfer your files onto a flash drive. The files created by the PAX (with extension *.W01) are directly compatible with the PDA-W and CAPWAP programs.

## File Size Adjust

This allows reducing the size of a PDA file (extension .W01) by discarding selected blows, and is accomplished by touching the W– button at the left on the first row of buttons underneath the graph. A screen similar to the one below will appear:

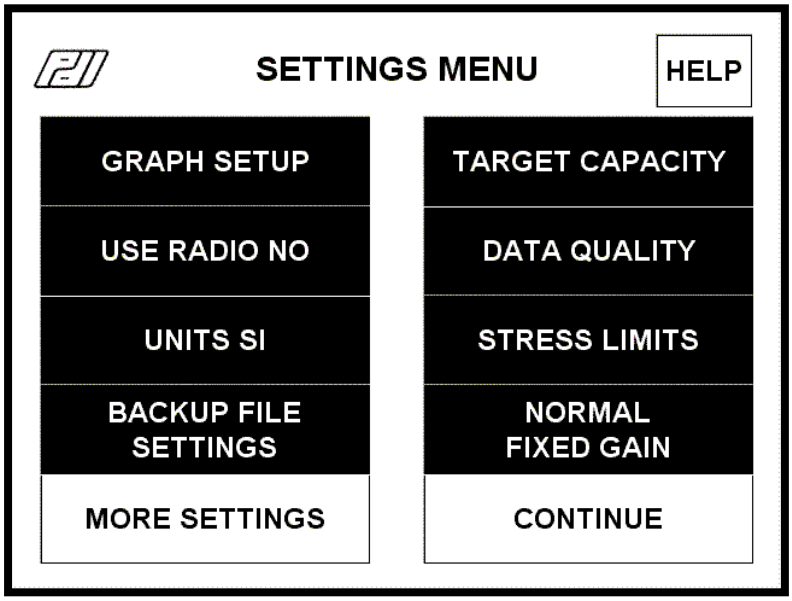



| | |
|---|---|
| Pre-adjust stats: | Shows information for the file BEFORE adjustments: Total number of blows (records) times the average size of each record plus a base (overhead) size equals the total estimated file size. |
| Post-Adjust stats: | Shows information for the file AFTER adjustments: Total number of blows (records) times the average size of each record plus a base (overhead) size |

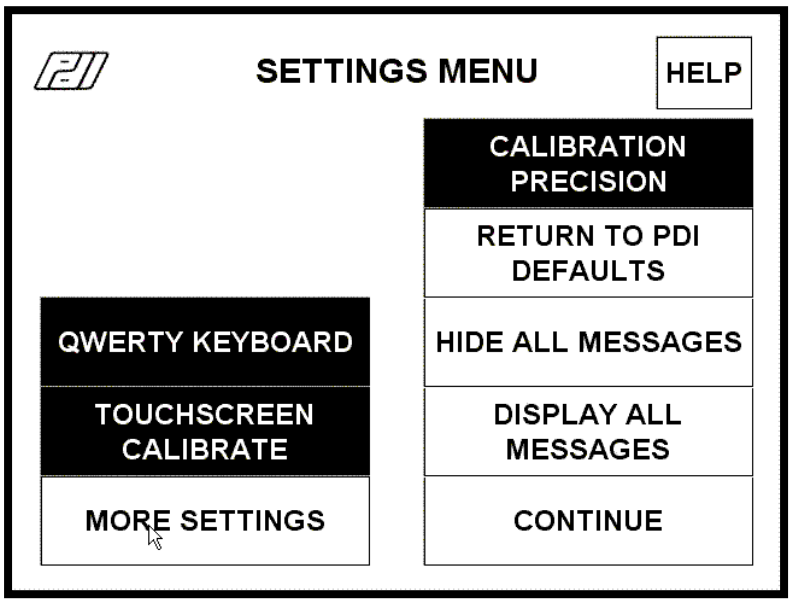
| | |
|---|---|
| | equals the total estimated file size. |
| First Location: | First location to save in adjusted file. Previous blows (records) will be discarded. Numbers at right show the total and last increment blow numbers for the selected location. |
| Save at Beginning: | Number of continuous blows (records) to save at the beginning of the file. |
| Save Frequency: | Frequency for saving blows (records) between (First Location + Save at Beginning) and (Last Location - Save at End); ex. 2 = save every other blow, 3 = save every three blows, etc. |
| Save at End: | Number of continuous blows (records) to save at the end of the file. |
| Last Location: | Last location to save in adjusted file. Further blows (records) will be discarded. Numbers at right show the total and last increment blow numbers for the selected location. |
| First Blow: | Blow number attributed to the first record on adjusted file. |
| OK | Accept changes. NOTE: changes will only be permanent after file is saved at the end of the review session. |
| ESC | Return to previous screen without any change. |

# Changing Settings

Touching the SETTINGS button on the Main Menu (page 11) will show the following screen:



Touch MORE SETTINGS to get to the next screen:




Touch MORE SETTINGS again to rotate between screens.

The following features may be accessed from these screens:

| | |
|---|---|
| GRAPH SETUP: | Allows changing the colors and styles of graph lines. It also allows turning the Axes, BETA, T1/T2 and Impact lines on or off. |
| USE RADIO: | Toggles between NO, YES MANUALLY CONNECT and YES AUTO CONNECT (see page 50). |
| UNITS SI: | Toggles the unit system between SI, English and Metric. |
| BACKUP FILE SETTINGS: | The PAX automatically saves a "squeezed" backup of every data set for thirty days in the PDIDataBackup directory. The first and last 40 records of the collected data are always saved. Touching this button opens up a screen that allows changing the frequency with which data will be saved between the first and last 40 records. Example: a Save Frequency of 10 (default) means every 10$^{th}$ record will be saved between the first and last 40 records. |
| TARGET CAPACITY | Opens a screen which allows setting the capacity below which a CL (Capacity Low) warning will be shown in the collect or replay screen. See page 40 for a description of the TARGET CAPACITY screen. |
| DATA QUALITY: | Opens the Data Quality Screen, which allows setting the thresholds for the on-screen alarms for Velocity and Displacement end (see page 41) |
| STRESS LIMITS: | Opens the Stress Limits Screen, which allows setting the thresholds for the on-screen alarms for stresses out of range. (see page 42) |
| NORMAL FIXED GAIN | Allows changing the Test Mode and Gain setting (see page 42). |
| QWERTY KEYBOARD | Toggles all alphanumeric keyboards between QWERTY (computer style) or ALPHA (alphabetic style) |
| TOUCHSCREEN CALIBRATE: | Starts a Calibrate Touch Screen routine (see page 40). |

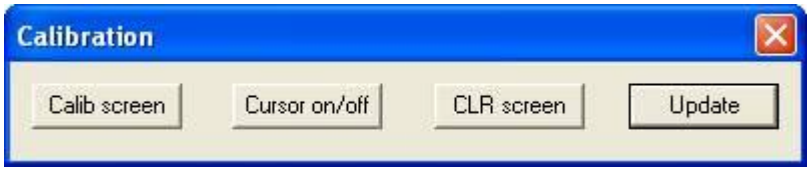
| | |
|---|---|
| CALIBRATION PRECISION: | Opens a screen which allows setting the precision (number of decimals) of the calibration factors shown in the Sensor Calibration Screen (see page 29) |
| HIDE ALL MESSAGES: | Hides all messages that have a check box "Do not display this message in the future" (like for example the screen shown on page 12) |
| DISPLAY ALL MESSAGES: | Turn back on all messages that were previously hidden. |
| CONTINUE: | Returns to Main Menu |
| PDI: | Shows information about Pile Dynamics, Inc. |
| HELP: | Opens on-line help feature. |

## Calibrate Touch Screen

Touch screen calibration may occasionally be necessary when the sensitive areas of the buttons seem to be displaced. It may be accomplished in one of two ways:

- Touching the Welcome Screen for approximately 10 seconds, or
- Touching the *Touchscreen Calibrate* button on the Settings Menu (see page 38 for the PDA-L program and page 85 for the PDA-R program).

The calibration procedure consists simply of touching the cross that will appear moving across the screen, as soon as it stops at a given location. After successfully calibrating the device, the following dialog appears:



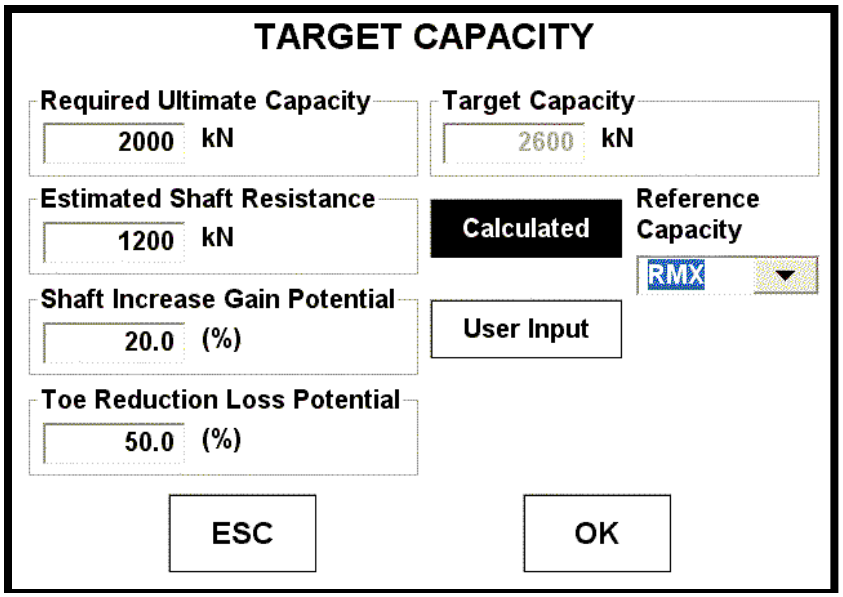

Hit the **Update** button to dismiss the program.

NOTE: Hitting the Close button  will generate an error message about a missing keyboard. This message can be ignored.

## Target Capacity Screen

This screen is accessible from the Settings Menu. It sets the Reference Capacity value below which a 

(Capacity Low) message will be displayed in the Collect or Replay Screen. The Target Capacity can be entered directly if "User Input" is selected, or calculated as shown in the example below:

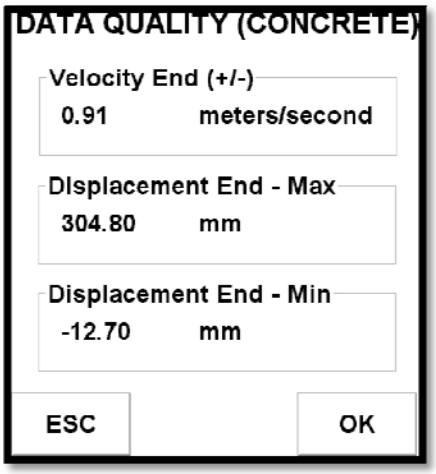



In the example, the required long-term ultimate capacity for that particular pile is 2000 kN, and it is estimated that 60% of that (1200 kN) will be skin friction. It is also estimated that the shaft resistance will increase 20% between its end of drive value and the long-term value of 1200 kN, and also that the end bearing will decrease 50% between its end of drive value and the long-term value of 800 kN. With this information the program calculated that the end of drive capacity that will result in the specified long term capacity of 2000 kN (or the "Target Capacity") is:

$$\frac{1200}{1+0.2}+\frac{800}{1-0.5}=2600\ kN$$

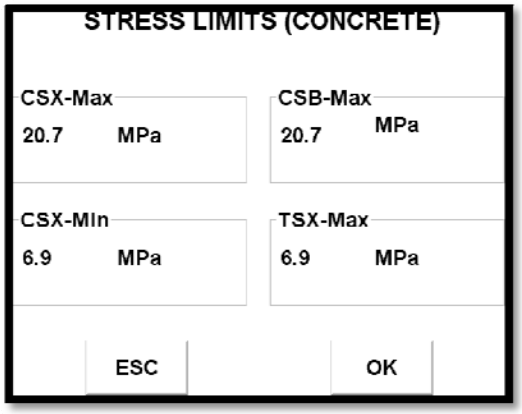
## Data Quality Screen

This screen is accessible from the Settings Menu. In the example below, the on-screen alarms (highlighted messages at the top of the screen) will pop up if the velocity at the end of the record is greater than 0.91 m/s or smaller than -0.91 m/s, or if the displacement at the end of the record is above 304.8 mm or less than -12.7 mm.



## Stress Limits Screen

This screen is accessible from the Settings Menu. In the example below, an on-screen alarm (highlighted message at the top of the screen) will pop up if the average compressive stress at the gages location (CSX) goes above 20.7 MPa or falls below 6.9 MPa. An alarm will also pop up if the Computed Stress at the Bottom (CSB) goes above 20.7 MPa or if the maximum calculated tension stress (TSX) goes above 6.9 MPa. The limits are stored for each foundation material (concrete, steel or timber) and displayed on the selected unit system.




## Test Mode and Gain Adjust

This screen is accessible from the Settings Menu, and has two sets of buttons: one for selecting *Normal* or *Restrike Mode*, and the other for selecting *Fixed Gain* or *Smart Gain Adjust*.

If Smart Gain Adjust is on, the PAX adjusts the gain of each individual acceleration channel according to the maximum values of the previous blows. Smart gain only starts after the fourth blow, so the initial gains are set according to the foundation material (Concrete, Steel or Timber) and the Normal or Restrike setting. Since the output of the analog to digital converter is divided by the gain, the PAX reading is not affected. However, the signal to noise ratio is greatly improved, especially with concrete and timber piles where the acceleration levels are usually well below the accelerometer range.

Smart Gain Adjust should only be used with fairly constant signal input. It is not recommended that it be used if the energy of the hammer is varied during the test.

# Special Features

## Area Calculator

This feature has tabs for selecting the most common types of pile geometry:

**Pipe** (round, tubular) - enter outside diameter (OD) and wall thickness (for solid round piles enter half of OD); the calculated Bottom Area and Perimeter assume a plugged (close ended) pile, and are used by the CAPWAP program. NOTE: This type of geometry will most likely be used for cast-in-place/drilled shafts; in those cases it is recommended that the perimeter at the gages location be measured, and that the corresponding diameter is entered assuming a perfectly round shape.

**Square** - enter width and diameter of void (or zero for no void); the calculated Bottom Area and Perimeter assume a plugged (close ended) pile, and are used by the CAPWAP program.

**Octagonal** - enter the width as shown and diameter of void (or zero for no void); the calculated Bottom Area and Perimeter assume a plugged (close ended) pile, and are used by the CAPWAP program. NOTE: the width of a regular octagon is the diameter of the circumscribed circle divided by 1.0824 (approximately).

**Hexagonal** - enter the width as shown and diameter of void (or zero for no void); the calculated Bottom Area and Perimeter assume a plugged (close ended) pile, and are used by the CAPWAP program. NOTE: the width of a regular hexagon is the diameter of the circumscribed circle divided by 1.1547 (approximately).

**Triangular** - enter the base size (an equilateral triangle is assumed) and diameter of void (or zero if no void); the calculated Bottom Area and Perimeter assume a plugged (close ended) pile, and are used by the CAPWAP program;

**H-Pile** - select from the lookup table; the calculated Bottom Area and Perimeter assume a fully plugged section, and are used by the CAPWAP program.

**Sheet Pile** - select from the lookup table (the letters S, D and T stand for Single, Double or Triple); the calculated Bottom Area and Perimeter assume a non-plugged section, and are used by the CAPWAP program.

**Taper** - This refers to Tapertube™ piles manufactured by DFP Foundation Products, LLC; the values provided by the area calculator are based on the manufacturer's specifications. The particular size of pile may be selected from the lookup table. The buttons at the top right allows filtering the list so that it only shows the types for a given top diameter (DTOP), Length or Thickness. The area shown is an average value for the whole pile - the actual area depends on where the gages are installed. The same is true for the Perimeter at the Top, which is the perimeter information that will be sent to the CAPWAP program. The bottom steel area and the

perimeter at the bottom are based on the nominal diameter at the pile bottom, and are shown for information purposes only. Touching the Filled Concrete button will recalculate the area for a concrete filled pile.

**Mono (Monotube)** - This refers to tapered piles made of corrugated steel manufactured by the Monotube® Pile Corporation; the values provided by the area calculator were taken from the manufacturer's catalog. The area is that at the top of the section; it will be correct if the gages are installed on the non-tapered extension section. If the gages are installed on the tapered section the area will have to be corrected according to the distance between the beginning of the tapered section and the gages location. The same is true for the Perimeter at the Top, which is the perimeter information that will be sent to the CAPWAP program. The bottom steel area and the perimeter at the bottom are based on the nominal diameter at the pile bottom, and are shown for information purposes only. Touching the Filled Concrete button will recalculate the area for a concrete filled pile.

# 2-Letter Commands

Direct keyboard entry is possible by using special commands which usually consist of two letters followed by input (value or character string). For example, typing *AR21.6* and then *OK* will change the area (AR) to 21.6.

If you know the variable in one units system, but are working in another, then appending a units letter (E, M or S) will change the input appropriately. For example, if you are operating in the English units system, LP17.7M will change LP of 17.7 m into 58 ft.

In a few cases a letter or multi-letter input may follow the initial two letter command. For example, typing *Q1RMX* will change the first quantity **Q1** to the **RMX** Case Method capacity computation.

A brief list of these two letter commands includes the following. No argument implies the function just produces the desired result directly. After entry of the command and argument (if appropriate), the command is executed by touching the OK button.

| Command | Argument | Function |
|---|---|---|
| OP | string | OPerator name |
| PN | string | Pile Name |
| PD | string | Description |
| WR | value | Weight of Ram |
| WH | value | Weight of Helmet |
| JC | value | Case damping constant |
| Q1 (also Q2... Q9) | string | Quantity (result) |
| LP | value | Length of Penetration |
| LI | value | add-on Length Increment |
| MB | value | Max Blow rate (BPM) |
| VT | value | Velocity Time shift |
| DL | value | DeLay |

| | | |
|---|---|---|
| FS | value | Force Scale |
| VS | value | Velocity Scale |
| DS | value | Displacement Scale |
| ES | value | Energy Scale |
| RS | value | Resistance Scale |
| TS | | Time Scale |
| TB | value | Time Beginning |
| CL | value | Compression Limit |
| LS | value | Length to Splice |
| PC | string | enter comments (notes) |
| UN | value | UNits |
| SET | value | user set/blow for QUS |

## Smoothing

FF applies a smoothing to the curves (boxcar filter with an input number of samples - e.g. FF3 takes the average of three running samples). The maximum FF value depends on the sampling frequency to prevent gross distortion of the data. FF filters both force and velocity data. The value for FF is normally one (no extra filtering) which is the PDI recommendation. New data will always default to 1. If FF is changed, it will be stored with the file and the replay will use the selected stored value. The Velocity may be filtered at a different rate using VF, although this is not recommended.

## VE – Velocity at the end of the record

This is the point where the Velocity at the End of the record is adjusted to zero. The curve is "pivoted" starting at the VA time (often point 100 or 200) of the data array to the VE time (data points are assigned values 0 to number of samples; usually the last data point is used for VE. Values of VE larger than that are ignored). The VE time may be selected earlier with this command. If the VE value is changed, a time marker will show the VE time where velocity is defined as zero. Use the VE button to change it to any value, and the VN or VP to move it left or right. This may be useful for lower sampling frequencies if the velocity curve then tends to "drift" or curve when it obviously should be flat. This feature is also helpful if the "assembly drop" occurs at the end of the record and thus the velocity is non zero at that time.

## WC Editing

There may be occasions where the overall wave speed for the entire foundation length (WC) is not consistent with the wave speed (WS) corresponding to the modulus and density at the transducer location. Direct input of WC is not allowed, but it may be adjusted by means of the right and left arrows on the Time Scale (TS) screen. NOTE: WC may originally differ slightly from WS due to the discrete sampling frequency.

The WC value should usually be equal to or less than WS. For example, the overall wave speed of concrete piles may be slowed due to cracking; WC significantly faster than elastic solution

wave speed WS should NEVER be used for UNIFORM driven piles. WC is used only for the 2L/c computation and does NOT affect the relationship between WS, SP and EM. WC might be faster than WS for multi-section spliced concrete piles where the top section has lower strength than a previously driven segment, or where the sensors are attached to the concrete in a composite pile with a concrete top section with a protruding long steel H pile at the bottom.

In the case of concrete piles, the overall wave speed may vary progressively during the driving of one pile due to minor tension cracking or joint related phenomena. In this case the user should use the rise-to-rise method to determine the overall wave speed (WC) used in the Case Method capacity computations. In practice, WC wave speed is almost always highest at the beginning of each data set, therefore determine the highest WC and make sure it is entered for the first blow (and WS set to this value). To adjust subsequent blows, select the WC Editing Mode from the Special Functions (FN) menu. There are three choices:

1. Constant for Pile (con) - means that any change in wave speed caused by left or right arrow keys will change effective wave speed WC of every blow.

2. Individual Blow by Blow (ind) - each blow may be independently adjusted by the left and right arrow keys. This option will be rarely needed for data entry except for perhaps files with only a very limited number of blows. This method is used after the "Blow by Blow Auto Edit" to keep the variable WC without further changes.

3. Blow by Blow Auto (auto) - in this mode, the user should start at the first blow of the data set with the assumed correct WC at the beginning of the data set (and correct WS). Each time the Up Arrow is pressed, the program goes to the next blow and assigns that blow the same WC as the previous blow. The user continues with Up Arrow until an adjustment is needed in WC; the adjustment is made on any blow with the left and right arrow keys prior to proceeding to the next blow with the Up Arrow. The user continues through the entire data set with the Up Arrow making adjustment when necessary as the WC gradually slows (or in rare cases increases). Note that Up Arrow does not change the WC value. When the WC has been properly adjusted for every blow, the file should be saved to retain these values for future use. For files with variable wave speed, after the WC has been adjusted for all blows in this "auto" mode, the wave speed calculation method should be changed to the "individual blow by blow edit" mode to prevent further accidental changes.

NOTE: In collect mode, the options above are only available when browsing data; when a new blow is detected WC will automatically change to the last value used.

# Wireless Gages (Radio) - Optional

# Introduction

This feature requires the purchase of wireless transmitters, like the one shown below:


# Charging the battery

You should charge the battery before using the transmitter. It should run for 8 hours after it has been fully charged. Full charge should normally take about 2 hours, or a maximum of 2.5 hours if the batteries are totally dead. Each transmitter comes with its own "Smart Li-ion Battery Charger". To charge the battery proceed as follows:

1. Make sure that the cap shown on the picture above is removed, so that the transmitter is powered off.
2. Plug in the connector from the charger to the battery charger plug.
3. Connect the charger to the AC mains (100 to 240 Volts AC – 50-60 Hz), using the power cord provided.
4. When the charger is connected to the AC mains, its LED will flash the sequence RED-GREEN-RED-GREEN. This is a self-check procedure that ensures that the internal circuitry is functioning properly.
5. The RED LED will then come on to indicate that the battery is charging in the high rate.
6. After the battery is charged the LED will change to GREEN to indicate that the battery is charged and ready to use. After some period of inactivity, the LED will start to cycle back and forth between red and green.

Caution:

- The charger is designed for indoor use only.
- Do not use the charger in wet areas.
- Do not use the charger near flammable substances or explosive fumes.

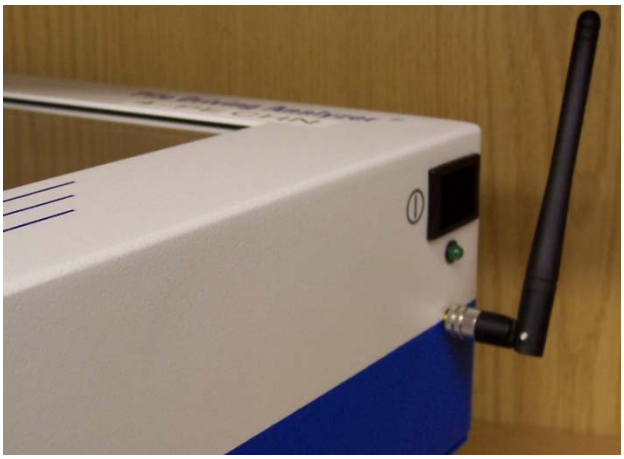
- The charger should be used only in horizontal position in a well ventilated area.
- Do not cover the charger or use it with ambient temperature above 40º C (104 º F).
- Do not touch the metal prongs of the input plug when plugging in or unplugging the charger.
- Remove charger from AC mains before connecting or disconnecting to the transmitter.
- Do not attempt to disassemble the charger. There are no user serviceable parts inside. There are high voltages present inside the unit, which may present a chock hazard if the part is disassembled.

# Using the wireless gages (radio)

Each transmitter accepts the signals from one strain gage and one Piezoresistive (PR) accelerometer (currently the wireless transmitters will not work with Piezoelectric (PE) accelerometers). The signal is sent digitally using Bluetooth technology over a distance of more than 100 m (330 ft). The PAX is equipped with two receivers, one for each strain gage-accelerometer-transmitter set. If your PAX unit came with two small connectors, one on each side, as shown in the picture below, then it is already "wireless ready", and needs no further modifications to work with the wireless transmitters. Just attach the two small antennas as shown in the picture below. If it does not have the connectors and you plan on using the wireless gages, you will have to send the unit back to Pile Dynamics for upgrading.

NOTE:

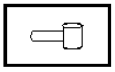
- Due to FCC requirements, the antenna connectors have reverse thread.

The radio transmitters can be used with the new "smart gages". These gages will send serial number and calibration data to the PAX, so the user is no longer required to enter this information manually. This greatly reduces the risk of errors during data collection. Currently the smart gage functionality is only available with the radio transmitters. The smart gages will work with standard cable transmission, but the serial number and calibration number information has to be entered manually.

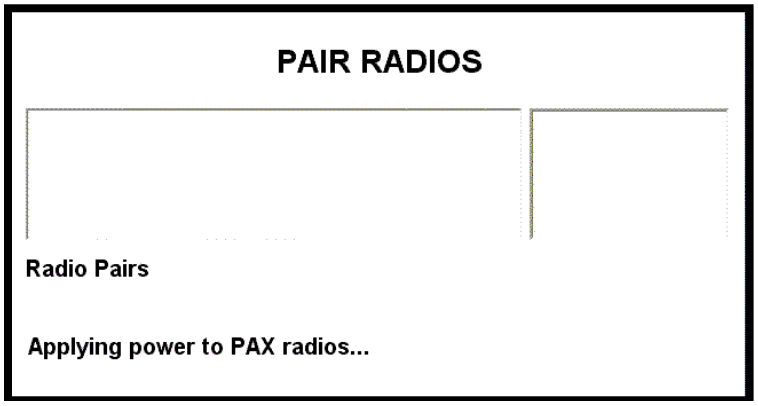
If wireless gages are being used, the *USE RADIO* button on the Condensed Setup Screen shown on page 9 (PDA-L program) or on page 60 (PDA-R program) should be toggled to YES; *CONNECT RADIOS* can be set either to MANUALLY (recommended) or to AUTO. It is also possible to switch the Radios on from the Main Menu, by touching *SETTINGS* and then toggling the corresponding button on the SETTINGS MENU screen (see page 38 for the PDA-L program and page 85 for the PDA-R program). Note that when *USE RADIO* is set to ON only the *4 - PR*

(four channels – Piezoresistive accelerometers) option will be available in the Main Menu shown on page 11; in this case, touching this button will have no effect.

When *USE RADIO* is set to ON, the following screen will appear after clicking on the  button when leaving the Pile Information Screen described on page 13.

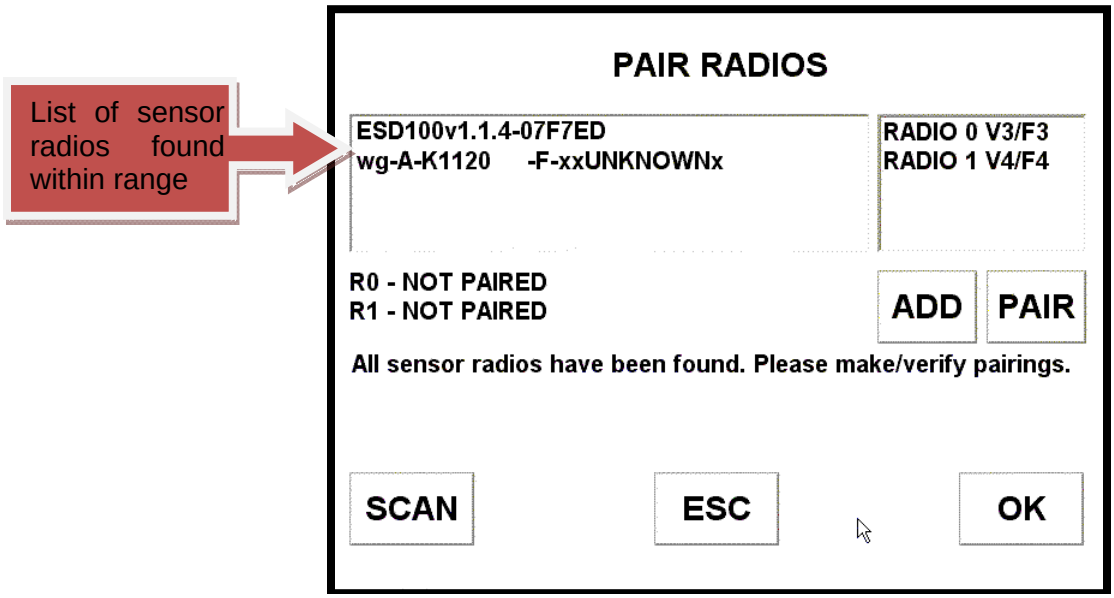
NOTES:

1. If the program is set to AUTO Connect Radios you will first get a screen saying "The PAX will locate and connect to 2 pile radio(s)..." Press *OK* to continue, or *ESC* to return to the previous screen.
2. It takes about 25 seconds from the time the transmitters are powered up until they are ready to be connected to the PAX.




The message "Applying power to PAX radios…" will change showing the steps that are being taken to set up the internal radio receivers and then to scan for compatible radio transmitters on range. After a few minutes (please be patient), the following screen should appear:

NOTE: if the unit is in AUTO Connect Radios this screen will be skipped; in this case the program will try to pair the radios automatically.



If the PAX has never been connected to pile radios before, then it will do an automatic scan in order to locate nearby pile radios. It is then necessary to pair each transmitter to a corresponding receiver, as described below. If the PAX has been connected to pile radios before, no SCAN will be done and no transmitters will be shown in the list. In this case, after touching OK on the PAIR RADIOS screen the PAX will try to connect to the pile radios using the previously stored configuration. However, it is highly recommended that the user does a SCAN (by touching the corresponding button), in order to verify that the expected pile radios are still available.

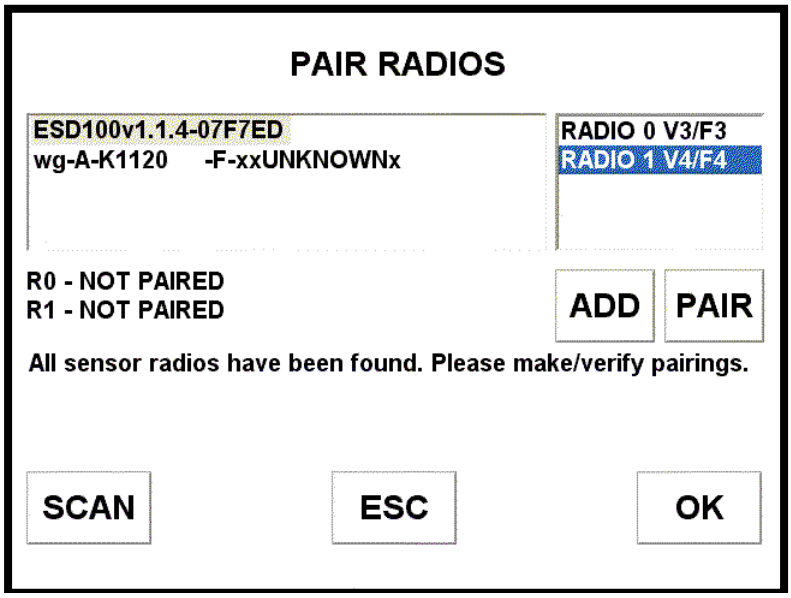
NOTE: Instead of doing a SCAN, it is also possible to manually add wireless gages transmitters by touching the *ADD* button, although this procedure is not recommended.

In the above example, after doing a SCAN two sensor radio transmitters were found within range:

ESD100v1.1.4-07F7ED — Since none of the gages used with this transmitter were "smart gages", the serial number and calibration information was not available. The "07F7ED" refers to the code stamped on the outside of the transmitter unit, which can be used to identify the particular unit. The user needs to know the serial numbers and calibration factors of the gages connected to this transmitter, in order to enter them manually.

Wg-A-K1120 -FxxUNKNOWNx — This transmitter had a "smart accelerometer" connected to it, so the PAX was able to identify its serial number (K1120). The calibration factor for this accelerometer will be automatically set. However, the Force gage was not "smart", and its serial number and calibration data will have to be entered manually.

To pair the radios, touch and highlight a transmitter on the left hand side and the receiver on the right hand side that it should pair with, as shown in the example below:



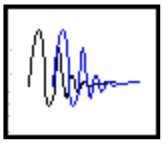
In this case the user wanted to set the gages connected to transmitter "07F7ED" to Radio 1, which corresponds to sensors V4 and F4. Touching on PAIR now will make the message "R1 – NOT PAIRED" change to "R1 – XXXXXX", where XXXXXX is the information corresponding to the selected transmitter. A similar procedure has to be done for the other transmitter-receiver pair. Touch OK after both radio receivers are paired, and a RADIO COMMUNICATION screen will come up, showing messages being exchanged between the PAX radio receivers and the transmitters. After a few seconds a BALANCING GAGES screen similar to the one shown on page 18 will appear. If non-smart sensors are used, as in the example above, a message like the one shown below may appear:


This only means that the program was not able to read serial number and calibration data for the strain gage connected to the transmitter that had been paired with Radio 0.

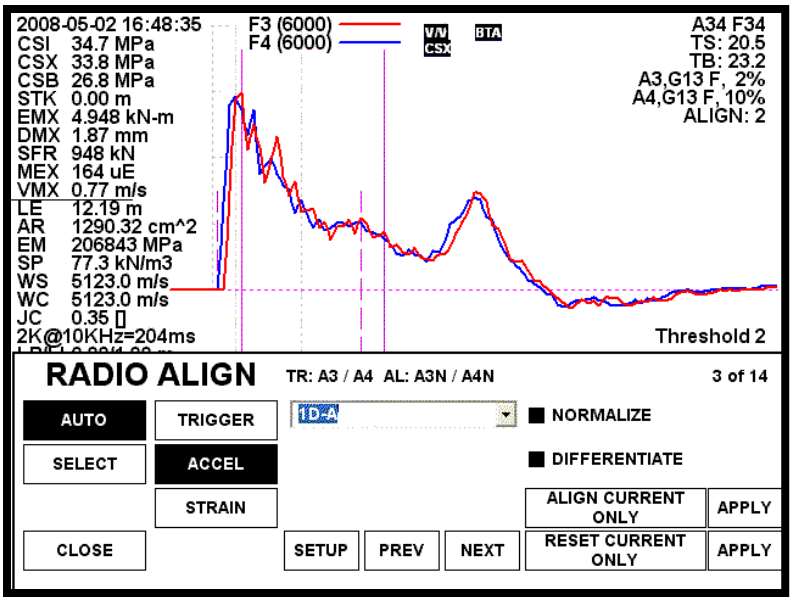
IMPORTANT: It is recommended to always make sure that a scan was done (either automatically or by touching the SCAN button), and then pair and connect the pile radio transmitters before attaching them to the pile. This guarantees that a connection can be made, batteries are charged, etc.

Pressing *CONTINUE* will show the Main Collect Screen shown on page 20. Data collection can now proceed normally as described on page 21. However, if any calibration number was not read correctly it is necessary to first enter the right serial number and calibration factor using the VF button, as described on page 29.

When Use Radio is ON some additional functions are available under $FN_3$ on the Main Collect Screen (see page 32):



**Radio Align** – because of slightly different timing of the different signal transmissions, when using radio the data is more subject to misalignment, that is, the two forces and/or the two velocities will appear as not starting to rise at the same time in the beginning of the blow. The program attempts an auto alignment of the signals; pressing this button brings up the screen shown below, which allows changing the alignment parameters. Severe misalignment may cause changes in the calculated results. The automatic adjustment should be capable of correcting the alignment to within acceptable limits, so it is unlikely that any correction will be necessary during data collection. Note that this feature is also available when Reviewing Data on the PAX (see page 36) or using the PDA-W program.




The picture above shows the two slightly misaligned force signals corresponding to record number 3 of a total of 14. The alignment tries to detect the abrupt change in the signals caused by the onset of the blow, and shifts the signals so that this change occurs at the same time for all of them. The default settings were determined from experience with a large number of different kinds of records, and should work well in most cases. Some fine tuning is possible using these functions:

| | |
|---|---|
| 1D-A (drop-down box) | Selects the method used; other options are Threshold 2 and Convolution 4. Selecting the NONE option turns off alignment. Note: "1D-A" was designed for optimum performance with minimum user intervention, and should give the best overall results. On the example above method "Threshold 2" was used, as indicated on the lower right side of the curves |
| SETUP | Allows entering additional parameters for the "Threshold 2" method. These parameters are: 1) the number of points used to determine the off-set (might be decreased for Diesel hammers where the signal does not stay parallel to the horizontal axis during the whole default number of samples) and 2) the threshold level (in percent of full scale – off-set will be added). |
| AUTO/SELECT | AUTO allows choosing between TRIGGER (tries to align based on the trigger channels), ACCEL (use Acceleration channels) and STRAIN (use Force channels). It will, however, automatically select the best channels to align on. SELECT allows choosing the pair of signals the program will try to align on. |
| PREV | Go to previous blow |
| NEXT | Go to next blow |
| NORMALIZE / | NORMALIZE adjusts the maximum amplitudes of the two signals before |

| | |
|---|---|
| DIFFERENTIATE | aligning, and should be used most of the times. DIFFERENTIATE acts on the force signal, to make it easier to detect abrupt changes. |
| ALIGN CURRENT ONLY | This button will toggle between this and ALIGN ALL, ALIGN 1ST TO CURRENT and ALIGN CURRENT TO END – Press APPLY to Align using the new settings. |
| RESET CURRENT ONLY | This button will toggle between this and RESET ALL, RESET 1ST TO CURRENT and RESET CURRENT TO END – Press APPLY to undo alignment and return to previous settings. |


This will stop data collection and reset the radios in the PAX. The program should be able to reestablish communication automatically after a loss of signal. This button should be used only as a last resort for resuming the test without having to close the current document.


This opens the RADIO COMMUNICATION screen. It shows the messages exchanged between the radio stations. Pressing the < or > button will toggle between RADIO TALK, INFO, PACKET, REJECTED and MONITOR, which are explained in more details below.

RADIO TALK: Shows the "conversation" between the PAX radios and the pile radios, when they are setting up their communication link. Its main use is as a diagnosis screen in case there is ever a problem.

INFO: Shows informational messages. It might also repeat data that popped up in messages boxes, such as errors reading calibration data because smart sensors were not used, etc.

PACKET: Logs the packets sent between the PAX and pile radios. These packets include, but are not limited to, packets of data, standby commands, accept commands, and acknowledge packets. This screen is helpful in diagnosis situations.

REJECTED: Logs the bytes of data that the PAX wasn't expecting to receive, and were therefore rejected.

MONITOR: Logs the packets sent and received, the rejected byte count, the index into the buffer and the line status. It is mostly diagnosis information. Also verifies that radio communication is still occurring if the PACKETS RECEIVED value increases even when active blow data is not occurring.

# PDA-R

# PDA-R Overview

When running the PDA-R program, your PAX will work in Remote Mode. In this mode data is transmitted in real time to a remote computer running the PDA-W software. Data can be transmitted using a high speed Internet connection for example through a broadband cell phone connected via USB, or using dial up data transmission through a data capable mobile phone also connected via USB.

The PDA-R program also allows the PAX to run in Standalone mode, without any remote connection. This mode is intended to accommodate cases where the field personnel are not trained in analyzing dynamic test data and a reliable remote connection cannot be established. In Standalone mode the PAX will save all the blows in PDA-W compatible format (W01 files), using default pile parameters and calibration numbers. No results will be available during data acquisition. The pile parameters and sensor calibration numbers will have to be corrected when reprocessing the files with the PDA-W software. Field personnel who are trained in the interpretation of dynamic pile test data should use the PAX Local Mode, by running the PDA-L program. In this mode the PAX performs as a full capability Pile Driving Analyzer coupled with a full capabilities personal computer, giving the field engineer access to all variables of interest on the spot.

In order to use the PAX in Remote Mode it is necessary to have the PDA-W program version 2007.098 or later installed on the remote computer. This manual also contains information on how to set-up the communication parameters on the PDA-W program. For further information on how to use the PDA-W software, please refer to its documentation.

# Preparing the PAX for Remote Mode Operation

Your PAX can transmit data using a Broadband Internet or a Dial Phone Connection. You should run the PDA-R program only after the unit is already connected to the data transmittal device, as described next.

## Internet Connection

Turn on the PAX, and follow your ISP (see Appendix E page A-19) or IT administrator instructions to connect it to the Internet. This usually involves loading drivers and a special program, or creating a new connection from the Control Panel. Note that this is a one-time process for each device through which you will transfer data. But establishing the Internet connection must be made prior to starting the PDA-R program if you want to transfer data to a PDA-W using the Internet. Make sure the connection is working properly.

NOTE: If you are using a cell phone to make the connection, make sure that it is not plugged in when the PAX is turned on, otherwise it may not start; connect the phone's USB connector to the PAX only after it is turned on.

WARNING: You should avoid using the Internet browser on your PAX, since the unit does not come with Anti-virus or any additional protection installed, except for the standard Windows XP (SP-2) firewall. Navigating the Internet in this condition makes your PAX an easy target for web sites or hackers that could install ad-ware or malicious software, and render the unit permanently unreliable or even non-operational. This could happen even if you are accessing reliable web sites, since you will then have an unprotected html port available to the outside world. Please note that the repair of the unit under these circumstances is not covered by warranty. Running the PDA-R program connected to the Internet does not pose any serious security risk, as it uses a proprietary format and will ignore all information coming in any other format.

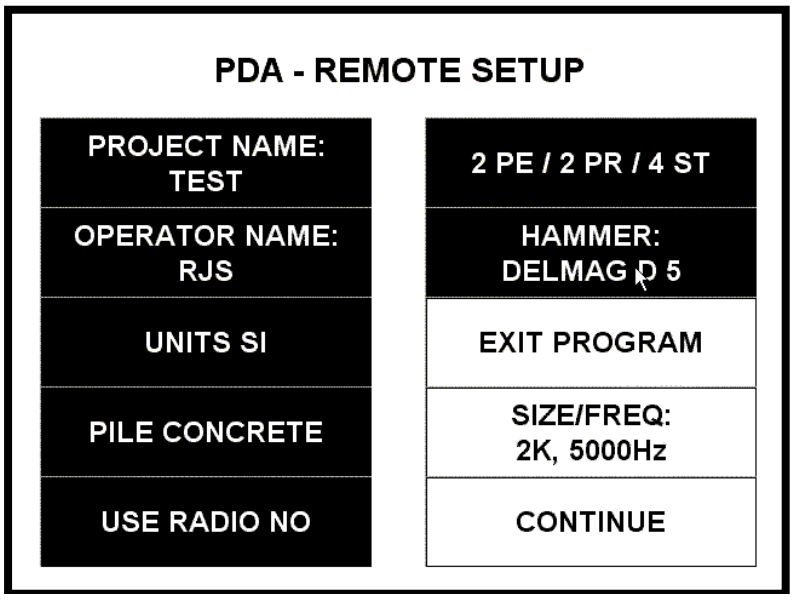
More general information on internet connections can be found in Appendix E on page A-19.

## Dial Phone Connection

Connect either an external Modem or a cell phone with Dial-up Modem capabilities to the USB port of your PAX. Install and test the external device according to the instructions supplied by the device manufacturer or by the cell phone provider.

# Condensed Setup Screen

After double clicking the shortcut to the PDA-R program you are taken to a Welcome Screen. Briefly touch it anywhere to get to the Condensed Setup Screen. After reviewing and changing the settings, you will click CONTINUE. In case you intend to transfer data using the Internet, you need to have the PAX unit already connected at this point, as explained above. The program will give you a chance of leaving it now in case your PAX is still not connected to the Internet. If it is already connected to the Internet, touch *CONTINUE*. This will take you to the Main Menu.



**PROJECT NAME:**
**TEST**
Click to enter or edit name of project

**OPERATOR NAME:**
**RJS**
Click to enter or edit name of operator

**UNITS SI**
Click to toggle through units: English, SI, Metric

**PILE CONCRETE**
Click to toggle through pile material: Steel, Concrete and Timber

**USE RADIO NO**
Use Wireless Gages – click to toggle through the other options: YES – MANUAL CONNET and YES – AUTO CONNECT. NOTE: Wireless Gages is not available on all models

**2 PE/ 2 PR/ 4 ST**
Click to select the number and type of transducers that will be used. The available options depend on the PAX model – 8 or 4 channels PE (piezo-electric) or PR (piezo-resistive) accelerometers. NOTE: if using Wireless gages (Radio), only the 2 PR / 2 ST (two piezoresistive accelerometers and two strain) is currently available.

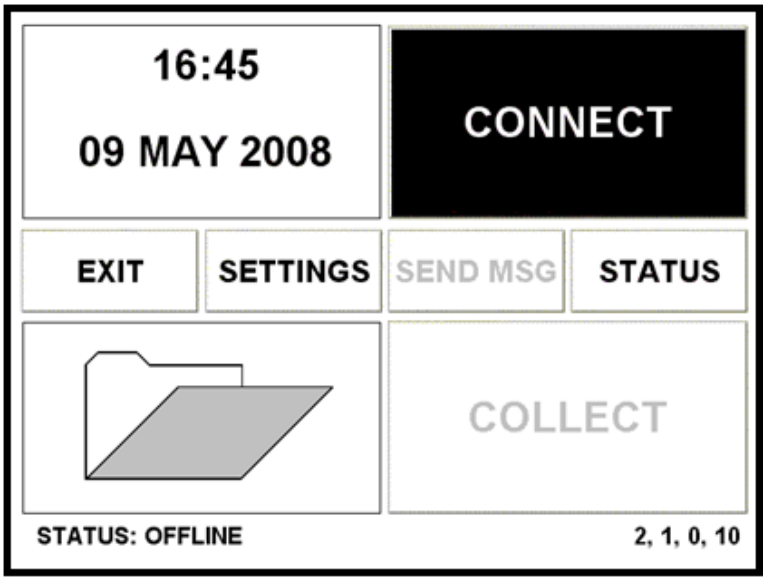
**HAMMER:**
**DELMAG D 5**
Click to select hammer information (opens a screen similar to the Hammer Tab described on page 14).

**EXIT PROGRAM**
Exits the program

**SIZE/FREQ:**
**2K, 5000Hz**
Shows the number of samples (in this example 2K or 2048 bytes) and the sampling frequency (in this example 5000 Hz). These parameters can only be changed from the SETTINGS option of the Main Menu (see page 85)

**CONTINUE**
Takes you to the Main Menu screen (described next)

# Main Menu




After clicking *CONTINUE* on the Condensed Setup Screen you will be taken to the Main Menu screen (shown above). By clicking on the upper left box, you will be allowed to edit the time and date. The upper right box will be flashing CONNECT until you establish a connection, after which it will show DISCONNECT (see next item for information on establishing a connection). The lower left box will take you to file review (see page 80 on retrieving and reviewing files). The lower right box will take you into collect mode (see page 70 on Collecting Data). On the middle bar, *EXIT* will exit the program, *SETTINGS* will take you into the settings menu (see page 85 for information on the settings), *SEND MSG* will allow you to send text messages to the remote PDA-W program. On the bottom of the screen, STATUS will display the connection status.

Touching the numbers that appear on the lower right corner of the Main Menu (2,1,0,10 on the example above) brings up an **"About"** screen. Please record and send the information contained on this screen when contacting PDI about your unit.

# Making the PDA Remote Connection

When you press the CONNECT button on the main menu, the next screen will ask you to choose your connection type: Internet, Dial Phone or Standalone.

## Internet Connection

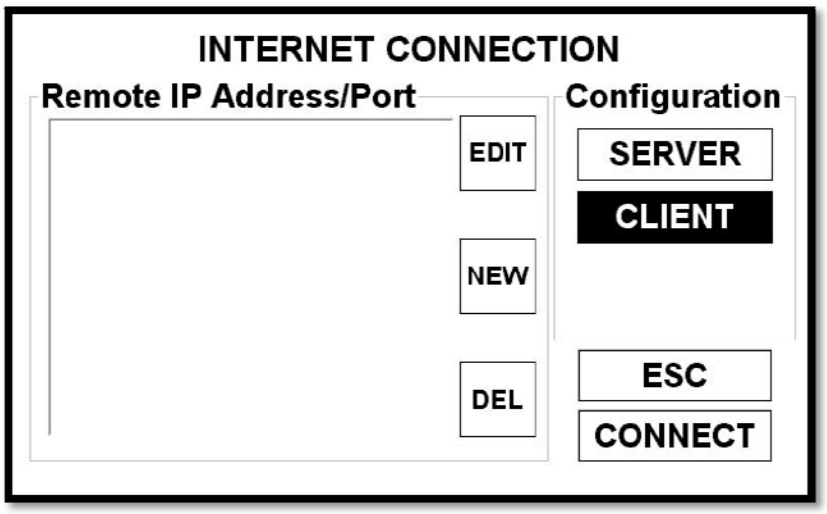
We recommend that the PAX be set-up as the Client and the PDA-W as the Server when using the Internet to transfer data. Should the Internet connection be dropped during the course of connection, the PAX will be able to automatically reconnect to the remote PDA-W. The PDA-W acting as the Server will have a fixed IP address. The PAX's broadband connection, on the

other hand, will most likely be set-up to provide a dynamic IP address. Dynamic IP addresses change. In case the PDA-W is set-up as the Client and the PAX as the Server, if the connection is dropped and the PAX's IP address changes, the PDA-W will have to be reprogrammed in order to be able to find the PAX automatically. Although in most cases it is possible to purchase a broadband connection so that it provides a static IP address for the PAX, the Internet provider will usually charge a much higher cost for this.

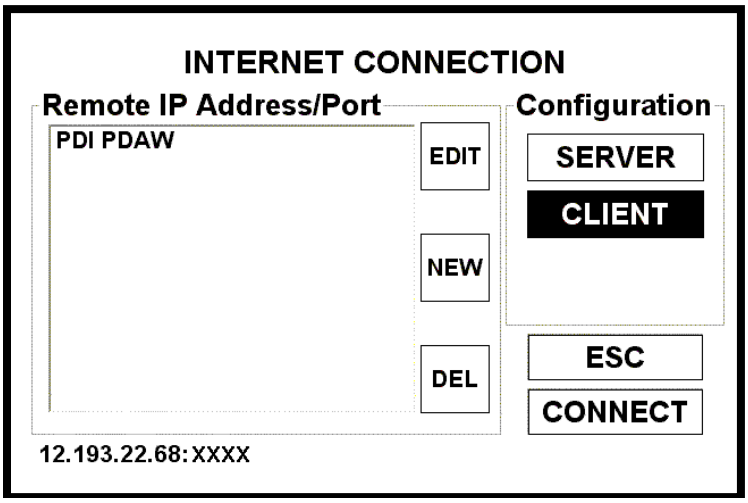
Now would be a good time to read *Finding the IP Address* in Appendix F – page A-25.

**Setting-up the PAX as the CLIENT**

To set-up the PAX to act as a Client choose CLIENT under **Configuration**, and you will see the window below:



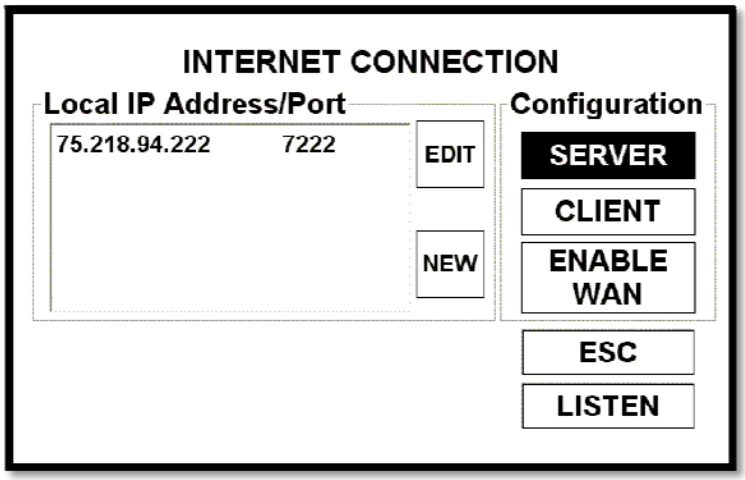

To set-up a new connection, touch *NEW* and then enter the IP address of the Server (in this case the computer running the PDA-W program in a remote location). After that, enter the port number to which the PDA-W program is attached to, and then enter a name for this connection - the connection parameters will be saved for future use.



This screen displays PDI's configuration in order to connect to a PDA-W program in our offices. (For security reasons, we have hidden the port number on which the PC running PDA-W is listening. If you ever need to send your data to our offices, the port number will be given to you at that time). Highlight your newly defined or some previously stored connection, and touch *CONNECT*. Your PAX will try to establish a connection with the PDA-W program at the given IP address and port.

**Setting-up the PAX as the SERVER**

In the less likely and not recommended case that you wish to configure the PAX as the Server the INTERNET CONNECTION screen will look as shown below:




In this case the list on the left side of the screen will show the IP addresses and Port numbers of all network connections found on your PAX. Usually only one number will be shown, corresponding to your Internet connection. Select this IP address and touch on the LISTEN button. You will be asked to confirm this unusual configuration. After you do that, the first time you connect you will get a message similar to the one below:

Touch on *Unblock* and then an *Internet Connection* screen will come up. At the top of this screen you will see a list of events, like SOCKETTE_LISTENING and SOCKETTE_ERROR - you can ignore those messages; they are only used for informational purposes. At the bottom of the screen you will see the messages *Listening on server XX.XXX.XX.XXX, port XXXX*, *Listening for XXX seconds* and *Please wait for client to connect...*The remote PDA-W should already be running and set as the Client, by entering the numbers shown on the message *Listening on server XX.XXX.XX.XXX, port XXXX* in the Remote IP Address/Port setting on the PAK-ette I/O Monitor screen. A few seconds later a connection should be automatically established, at which point the screen on the PAX will return to the Main Menu, but with the *CONNECT* button now showing *DISCONNECT*. You are now ready to start collecting data.

NOTE: The Port number defaults to 7000 plus the last group of digits in your IP Address (in the example above: last group of digits = 235, so Port number is 7235). You can change that by touching the *Edit* button (the *NEW* button has no function at this time).

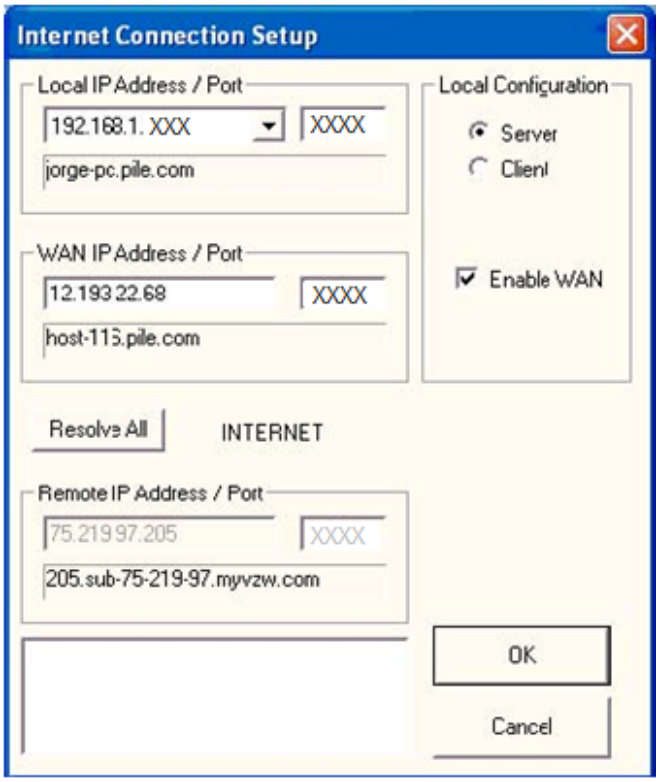
> WARNING: Port numbers below 1023 are reserved for other applications and should not be used.

The *ENABLE WAN* button is used when your PAX is connected to a LAN behind a firewall. This should be an extremely rare situation. If this is the case, you will have a sufficiently trained IT department that will be able to provide you with the necessary directions to establish your connection.

**Setting-up the PDA-W program**

- Start the program on the remote computer. Click on *Setup* > *Serial Analog/Digital (SAD)* and choose *Remote - PAL Connected Via Modem*. You will see two new minimized windows at the bottom of the screen. One is titled *Message Exchange* and the other *PAK-ette I/O Monitor*.
- Open the one that says PAK-ette I/O Monitor, either by clicking on the  button or on the title bar and then selecting *Restore*. NOTE: This window appears as SADCOM on the Windows task bar; it can also be opened by clicking on this button.
- Click on the *Connection* menu item, and choose *Internet.*
- Click on the button at the lower right part of the screen that says *Configure Internet,* or click on the *Setup* menu item and choose *Internet(IP/Port).*

If the PDA-W program will be configured as the Server (this is the usual and recommended configuration), choose the appropriate selection under *Local Configuration* and you will see a window similar to this:

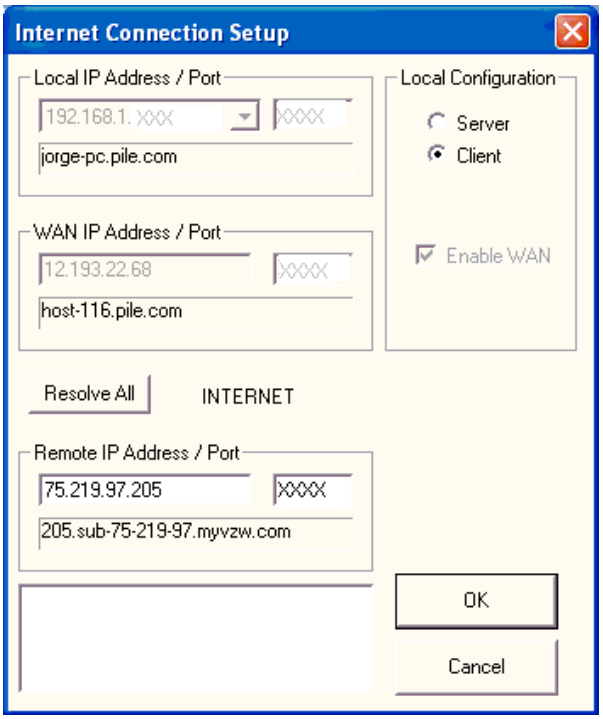



The box under Local IP Address has a list of all available network connections. For security purposes, we have hidden the last group of digits (octet) of our IP addresses and our port numbers. Usually there is only one (in the example above this is a local network address, as the computer where the PDA-W program was running was connected to a LAN). The port number defaults to 7000 plus the last octet in your IP address. You can change the port number if you want (please note that if your computer is connected to a LAN you will need to set-up Port Forwarding to this port number - see page A-21 on Appendix F for further explanation). WARNING: Port numbers below 1023 are reserved for other applications and should not be used. In the example above, since the computer running the PDA-W program was connected to a LAN, the address of the Internet connection was not the same as the Local IP Address. In this case the *Enable WAN* box was checked and the actual Internet connection address was entered (see Appendix F for further information). Click on OK and the PAK-ette I/O Monitor will show a message *Listening on XX.XXX.XXX.XXX:XXX*, and the button at the left of *Configure Internet* will show *CONNECTION CONTROL PANEL -INTERNET SERVER: XX.XXX.XXX.XXX:XXXX*, and if WAN is enabled it will also show *<FWD> XXX.XXX.XXX.XXX:XXXX*. The program will keep monitoring the specified IP address and port for incoming data.

NOTE: The first time the PDA-W is set as a Server, after clicking OK you may see a screen similar to the one below:


The message can be different, depending on the Firewall protection that you have installed on your computer. The example above shows the message generated by the Windows XP (SP-2) firewall. Click on *Unblock* to proceed. You usually have to do it only once, and the firewall program will memorize the setting the next time that the SADCOM program (which is a part of the PDA-W program) attempts to connect to the Internet as a Server. Refer to your Firewall protection program for further information.

In the less probable case that you wish to configure the PDA-W program as the Client, the *Internet Connection Setup* screen will look as follows:




NOTE: For security purposes, we have hidden the last octet of our IP addresses and our port numbers.

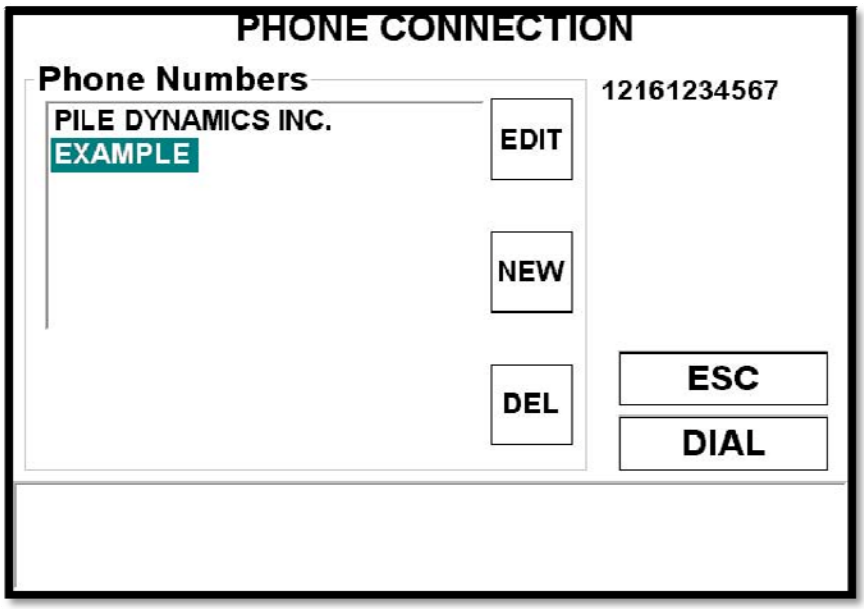
In this case you have to enter the PAX IP address and Port in the *Remote IP Address/Port* box.

The PAK-ette I/o Monitor will show a message:
WAITING FOR CONNECTION TO XX.XXXX.XXX.XXX:XXXX

The button at the left of Configure Internet will show:
*CONNECTION CONTROL PANEL - INTERNET CLIENT: XX.XXX.XXX.XXX:XXXX (SERVER=XX.XXX.XXX.XXX:XXXX)*

# Dial Phone Connection

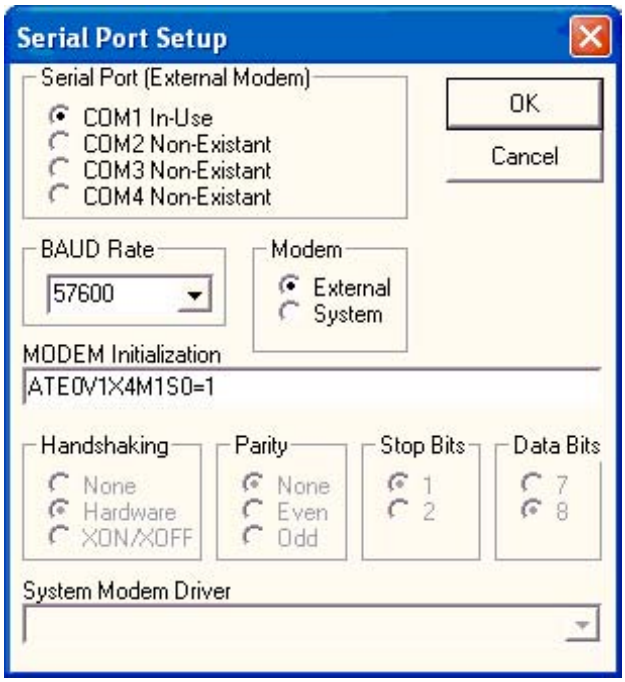
**Setting-up the PAX**
To set-up a new connection, touch *NEW*, and then enter the complete phone number that the Modem will have to dial. After that enter a name for this connection - the connection parameters will be saved for future use. Highlight this or some previously stored connection, and touch *DIAL*. Your PAX will dial the requested number, trying to establish a connection with the PDA-W program running on the remote computer.




**Setting-up the PDA-W program**

- Start the program on the remote computer. Click on *Setup > Serial Analog/Digital (SAD)* and choose *Remote - PAL Connected Via Modem*. You will see two new minimized windows at the bottom of the screen. One is titled *Message Exchange* and the other *PAK-ette I/O Monitor*.
- Open the one that says PAK-ette I/O Monitor, either by clicking on the  button or on the title bar and then selecting *Restore*. NOTE: This window appears as SADCOM on the Windows task bar; it can also be opened by clicking on this button.

- Click on the *Connection* menu item, and choose *Modem*
- Click on the button at the lower right part of the screen that says *Configure Modem.* The following screen will come up:




The example above shows the set-up when you have an external modem connected to the computer. Select the COM serial port to where the Modem is connected, and adjust the Baud Rate and MODEM Initialization string according the Modem's instructions and then click *OK*.

If your computer has an internal (built-in) modem, on the selections under *Modem* select *System*. Clicking on the down arrow at the right of the System Modem Driver box will show a list of the available Modems (usually there is only one). Select the Modem and click on *OK.* In this case all other settings like BAUD rate and MODEM Initialization will be automatically adjusted by the program.

## Standalone Mode

In Standalone mode the PDA-R program will allow data collection without any remote connection. This mode is intended to accommodate cases where the field personnel are not trained in analyzing dynamic test data and a reliable remote connection cannot be established. In Standalone mode the PAX will save all the blows in PDA-W compatible format (W01 files), using default pile parameters and calibration numbers. No results will be available during data acquisition. The pile parameters and sensor calibration numbers will have to be corrected when reprocessing the files with the PDA-W software.

There are slight differences in the Collect Screen (see page 75) and in the Review Screen (see page 80) if you are in Standalone Mode, since only in this mode the user will be allowed to change the vertical and horizontal scales and to switch transducers on or off in the PAX. When the PAX is connected to a remote computer this can only be done in the PDA-W program.

# Collecting Data

After achieving an Internet or Dial Phone Connection, or after selecting the Standalone option, you will be taken back to the Main Menu (page 62). The status on the lower left corner of the screen should now say CONNECTED or STANDALONE. To begin collecting data, click on the COLLECT button on the Main Menu.

If wireless gages are not being used (sensors connected to the PAX via cable), a screen will be shown which allows going back to the Main Menu, in case the user wishes to make changes to the Strike or Adjust Modes. If you want to change the Strike and/or the Gain Adjust Mode at this time touch ESC and choose SETTINGS on the Main Menu (see page 85). If not touch on OK and you will be taken to the PILE INORMATION screen described next. Note that you can also change from NORMAL to RESTRIKE on this screen.

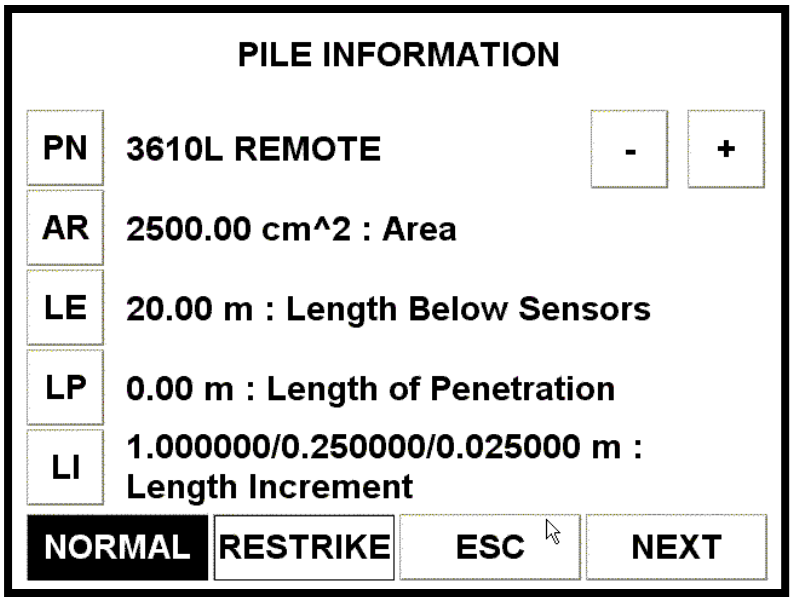
If wireless gages (radio) are being used, you will be taken directly to the PILE INFORMATION screen shown next.

NOTE:

- If set to NORMAL strike, the PAX may skip blows so that the remote computer is always able to see the most recent blow available. The number of blows skipped will depend on the connection speed and on the hammer blow rate, but the skipped blows will still be saved on the PAX and can later be transferred using for example a memory stick connected to the USB port.
- If set to RESTRIKE the PAX will send every blow, so when using this option it is likely that sending will fall behind data collection. The RESTRIKE option is meant to be used when the total number of blows is small, and therefore the time it will take to send every blow is minimal, especially using a broadband (Internet) connection.
- Smart gain adjusts the gain of each individual acceleration channel according to the maximum values of the previous blows. The initial gains are set according to the type of foundation material (Concrete, Steel or Timber) and the Normal or Restrike setting. This feature can improve the signal to noise ratio of signals with fairly constant amplitudes, but may not be adequate for recording blows with variable energy (like in drilled shaft testing, during Diesel hammers start-up, etc).

# Pile Information Screen

The screen below should appear after pressing COLLECT on the main screen (if wireless gages are being used) or after pressing OK on the Strike and Adjust Mode Information screen.




Touch the appropriate buttons on the left to make changes:

**PN** - Pile Name or touch the '-' or '+' button to decrement or increment only the numeric part of the Pile Name.

**AR** – Cross-section area at the gages location (only available in Standalone Mode); this will bring up the Area Calculator (see page 43). Choose the geometry of the pile and enter the required dimensions, then touch OK to transfer the calculated area value. NOTE: if not in Standalone Mode the area can only be entered on the remote PDA-W program.

**LE** - Length below Gages

**LP** - Initial Length of Penetration

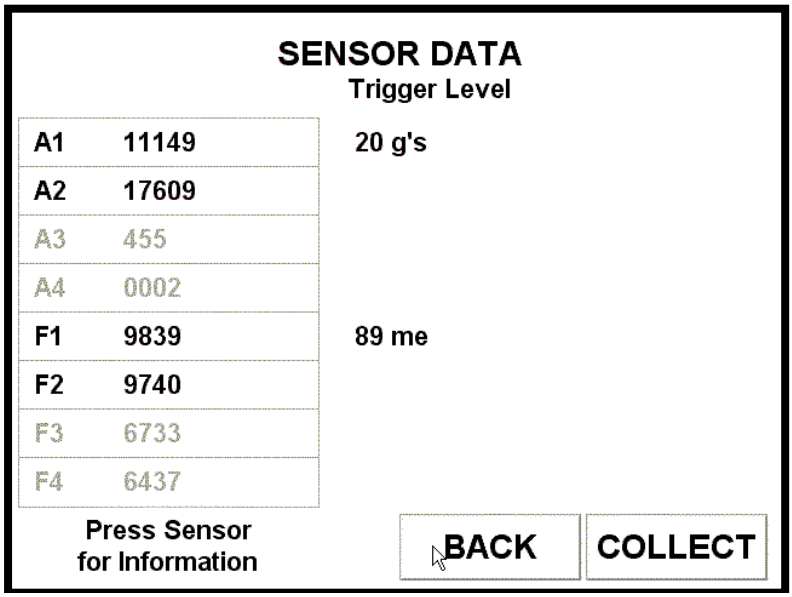
**LI** - Length Increment - LP will be incremented by this value each time the LP+ button on the Data Acquisition screen or the remote blow count switch is pressed. NOTE: Up to three different values are possible for LI in Metric or SI units and two values for English units.

**NORMAL** - If set to NORMAL strike, the PAX may skip blows so that the remote computer is always able to see the most recent blow available. The number of blows skipped will depend on the connection speed and on the hammer blow rate, but the skipped blows will still be saved on the PAX and can later be transferred using for example a memory stick connected to the USB port.

**RESTRIKE** - If set to RESTRIKE the PAX will send every blow, so when using this option it is likely that sending will fall behind data collection. The RESTRIKE option is meant to be used when the total number of blows is small, and therefore the time it will take to send every blow is minimal, especially using a broadband (Internet) connection.

If you are connected to a remote PDA-W program either through the Internet or through a Dial Phone connection, the NEXT button will say COLLECT. Touching this button at this point will take you directly to the Balancing Gages Screen (see page 73).

If you are in Standalone Mode touch the NEXT button, and you will be asked to confirm the type of pile material (Steel, Concrete or Timber - this information will be used to set the default elastic modulus and specific weight). Touch NEXT again and you will be taken to the SENSOR DATA Screen shown below.




This screen contains buttons corresponding to each active sensor. Touch the button corresponding to a given sensor, and try to find its serial number in the pop-up list. If you cannot find it, select the one that has INT CAL in its name (for example F1 INT CAL, etc). You can also change the Trigger Level on this screen, by touching the corresponding numbers (in the example above, 20 g's for the acceleration channels and 89 με for the force channels). Changing the Trigger Levels might be necessary if the unit does not display any signal upon a hammer impact, even though it is in Accept Mode and everything seems to be in order - see page 16 for a more detailed explanation on when and how to change the Trigger Level. After checking all transducer calibration numbers touch *COLLECT* to go to the BALANCING GAGES Screen (next page).

WARNING: In Standalone mode the PAX will generate a file that can be later transferred to a computer running the PDA-W program (file with extension W01). However, it will use default values for the cross-section area, specific weight and sensor calibration factors, which will probably be incorrect. In this case the user in the field should take note of these parameters, so that they can later be corrected in the PDA-W program. In this mode of operation no results will be available during the test.

# Balancing Gages

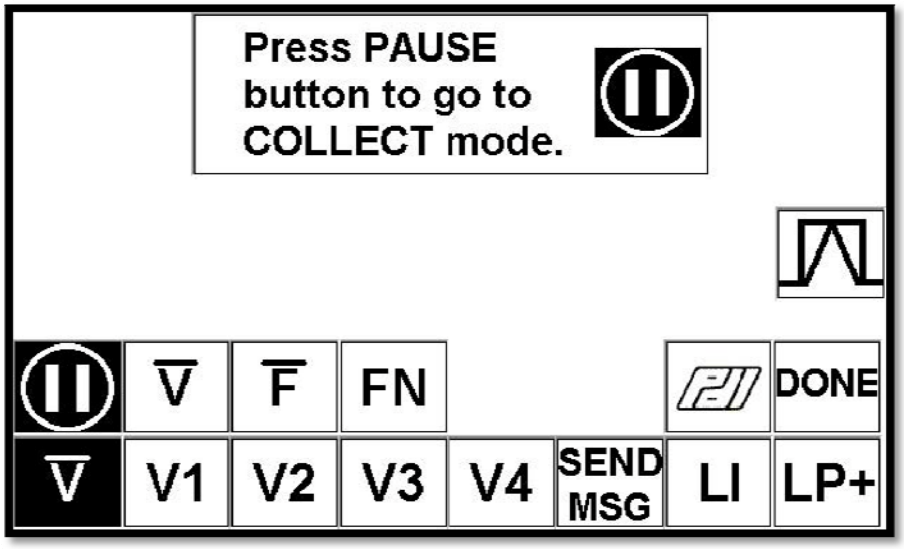
Prior to acquiring data, you should first check the sensor offsets. The Balancing Gages screen appears when starting to acquire new data, or during data collection by clicking the OF button. This screen is similar to the one described on page 18 for the PDA-L program. A brief description is repeated here for convenience.

A few seconds after entering this screen, all sensors should show "OK". Any message of "Not Balanced" may mean a problem with the corresponding sensor and/or cable. For the strain gages, if you get a "Not Balanced" message you should loosen that sensor and adjust (stretching or compressing the sensor) prior to data collection to prevent "clipped signals" in the A/D process which make the data useless. Negative values indicate the sensor is currently in a tension condition; positive values indicate the sensor is in a compression condition. The main cause of bad offsets in strain gages is either non-flat mounting surfaces or incorrect spacing between the holes (3 inch or 76 mm). It is imperative that the hole spacing be correct for the strain sensors to function properly. Use a drilling template on concrete piles.

If all gages are properly balanced touch OK to go to the MAIN COLLECT Screen described next.

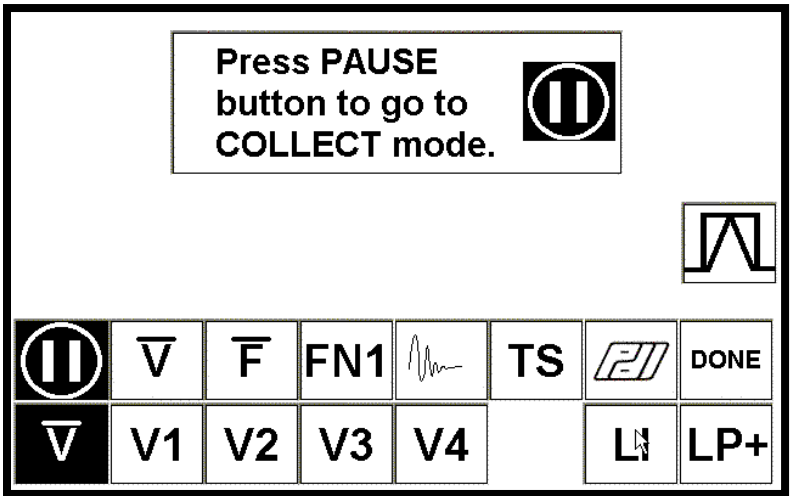
# Main Collect Screen

After you press OK on the Balancing Gages Screen you will be taken to the Main Collect Screen. If you are connected to a remote PDA-W program either through the Internet or through a Dial Phone connection it should look similar to the picture below:



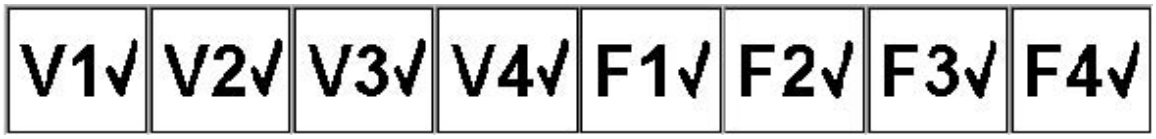

Touching the FN button will make the last row of buttons display:


If you are in STANDALONE MODE, the screen will appear a little different:




Touching the FN1 button will make the last row of buttons show:


Touching the FN1 button again will change into FN2 and the last row of buttons will now show:




NOTE: The V1, V2, V3, V4, F1, F2, F3 and F4 buttons will appear or not depending on the PAX model (4 or 8 channels) and on the choice made on the Settings Menu (which can be reached from the Main Menu - see page 85).

If Wireless Gages (Radio) are being used, an additional button PAIR RADIOS will be blinking at the left of the button. If this is the case, before starting to collect data as described in the next section you have to pair the radios, by pressing this button and following the instructions described on page 51. Note that if you are not in Standalone Mode, before pairing the radios

you have to create the PDA-W document. This is accomplished by touching the  button, as described in the next section.

The specific operations of these various functions will be discussed in the following pages.

## Collecting Data

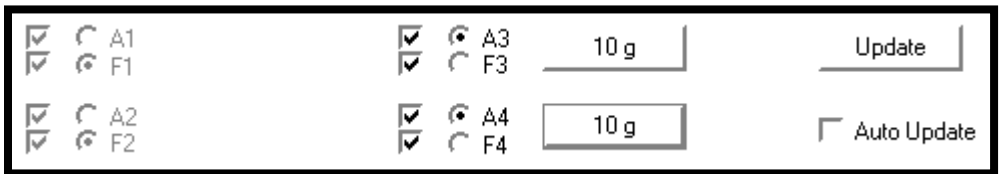
To start collecting data, first touch the  button on the left side of the screen, so that it now shows the  button, this will put you into accept mode and will be able to start collecting data.

NOTE: if you are using Wireless Gages (Radio), you should now touch the 

button to pair the radios as described on page 51.

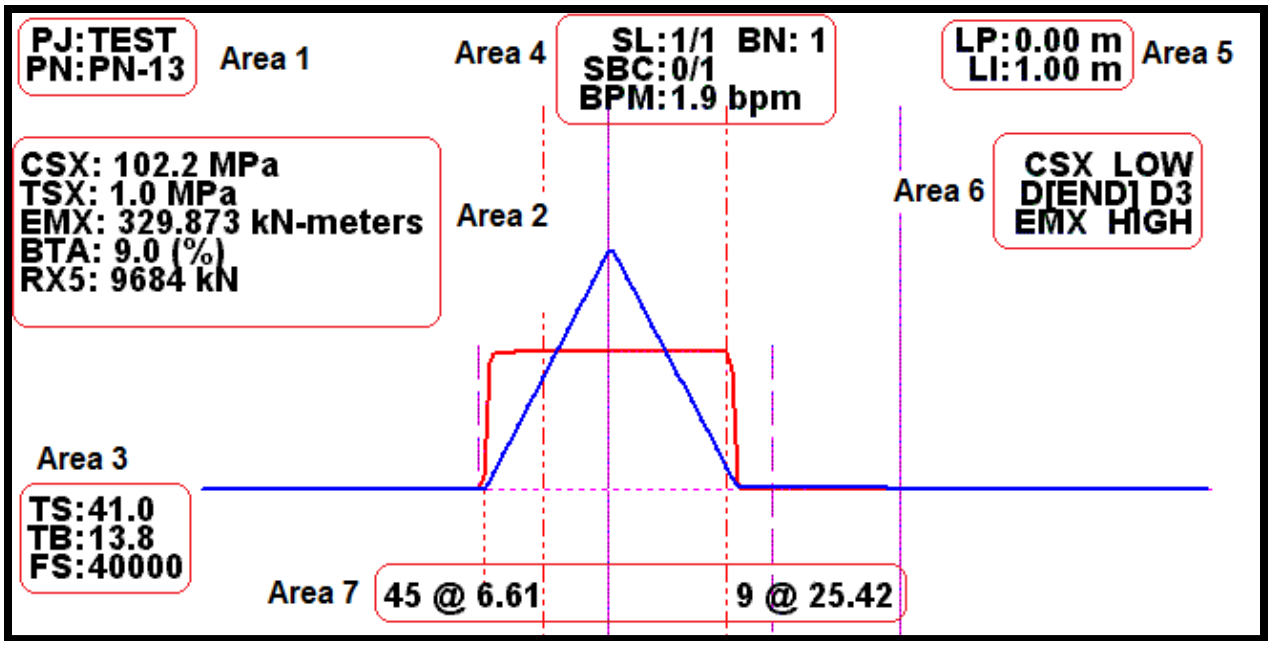
Unless you are in Standby Mode, this will create a new document in the remote PDA-W program. The document will open with the parameters (AR, EM, SP, PD, calibration factors) saved from the previous test. Note that if you are using smart wireless gages, the calibration factors will be replaced with those read from the gages. Those parameters can only be changed in the PDA-W program. The pile name (PN), length below gages (LE) and penetration (LP) are set to the values entered in the PAX, but can later be changed in the PDA-W program, if necessary. Please refer to the PDA-W on-line help or manual for further information.

When in collect mode, a panel similar to the one below will be shown on the upper part of the remote PDA-W screen:




The example above is for wireless gages, so the controls for A1, F1, A2 and F2 are disabled (only piezoresistive accelerometers are being used). The check boxes on the left are for switching the corresponding gages on or off, and the radio buttons on the right of the check boxes are for selecting the trigger channel (in the above example A3 is being used for one of the radios, and A4 is being used for the other one). The buttons labeled "10 g" can be used for changing the trigger levels (see page 16). After any change is made, the *Update* button has to be pressed in order for the new configuration to be sent to the PAX, unless the *Auto Update* box is checked. The use of *Auto Update* is not usually recommended, since a quick succession of changes can have unpredictable results due to the amount of time it takes for the instructions to be transmitted from the remote PDA-W to the PAX.

To collect data you should first generate a calibration signal by pressing the  button on the left side on the screen. You should see a signal similar to the picture below:




NOTE: The actual image probably will not look exactly the same because of different scale settings. If you are connected to a remote computer the scales can only be adjusted on the PDA-W program. If you are in Standalone the vertical scales can be adjusted by touching the button and the horizontal scale by touching the TS button (see pages 23-24 for more information on adjusting the vertical and horizontal scale). The line colors and styles can be changed by touching Settings on the Main Menu, and then choosing Graph Setup (see page 85).

Below is an explanation of the different results and messages that appear on the screen:

| Area 1 | |
|---|---|
| PJ | Project Name |
| PN | Pile Number |
| **Area 2 (see note 1 below)** | |
| CSX | Maximum compressive stress at the gages location |
| TSX | Maximum tension stress along the pile |
| EMX | Maximum energy transferred to the pile |
| BTA | Minimum BETA value (indicates possible damage if <100) |
| RX5 | CASE method capacity with JC = 0.5 |
| **Area 3 (see note 2 below)** | |
| TS: 41.0 | Time (horizontal) scale – 41.0 ms in this example |
| TB: 13.8 | Time of beginning – in the example, the display starts 13.8 ms after the beginning of the recorded signal |
| FS: 40000 | Force Scale – in the example, the bottom of the BPM line corresponds to 40000 kN |
| **Area 4** | |
| SL:1/1 BN: 1 | Save Location (the number on the left shows the current location and the number on the right shows the total records saved) and Blow Number |

| | |
|---|---|
| SBC 0/1 | Small Blow Count – When LP+ is pressed, the current blow count is transferred from the right to the left, and a new count starts on the right. |
| BPM: 1.9 bpm | Number of Blows per Minute |
| Area 5 | |
| LP | Length of Penetration. Press LP+ or the blow count switch to increment |
| LI | Length Increment. Press LI to toggle between the different increments |
| Area 6 | |
| CSX LOW… | Shows a subset of the warning messages displayed on the top of the remote PDA-W screen |
| Area 7 (see note 1 below) | |
| 45 @ 6.61 | BETA indicator. In this example, a BETA factor of 45% was detected at 6.61 m below the gages |
| 9 @ 25.42 | Second BETA indicator. In this example, a second BETA factor of 9% was detected 25.42 m below the gages |

Note:

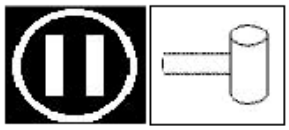
1. These values are calculated locally by the PDA-R program, using less refined methods than the PDA-W program. Therefore, small differences may exist between those results and the ones shown on the remote PDA-W program. The computations on the remote PDA-W are the exact ones. Also please have in mind that due to the time it takes to transmit the data, the blow seen on the PDA-W may not be the same shown on the PAX.
2. The horizontal and vertical scales can only be changed on the remote PDA-W program.

If piezoelectric accelerometers are being used the bottom part of the screen will then say "Calibration requires a 15 second wait - Time remaining before data collection resumes XX seconds". After the countdown reaches zero and your settings are as desired, you can start applying the blows and recording data.

Once driving is completed, click on the DONE button. This will take you back to the MAIN MENU (page 62). Repeat the same steps for the other piles to be tested.

# Functions

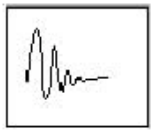
For further information on the specific functions of the following buttons, see the appropriate sections of this manual.



Toggle between Collect and Standby. When the pause button is displayed the PAX is in collect mode.


Change between average or individual force and velocity (see page 80). Only one force and one velocity curve will be displayed; the average force and one of the individual force traces; the average velocity or one of the individual velocity traces.


(or FN1 or FN2) Toggles the functions that appear on the last row of buttons.



Changes vertical scale (see page 82)


Changes horizontal time scale (see page 83)

PDI Logo


Done collecting data for current pile; saves data and returns to Main Menu.

Generates a calibration signal (see page 21)


Gage offsets, balancing gages (see page 73)


Shows a screen that allows viewing or changing the trigger channel(s) – Standalone Mode only.


Allows the user to change the selected sensor(s) – Standalone Mode only.


Sends text message to the computer running the PDA-W program


Adds a note or comment to the current record (see page 84) – Standalone Mode only.


Opens the on-line help


Toggles the length increment (LI) and increases the length of penetration (LP+) during driving by the LI.

# Reviewing Stored Data

You may see a list of previously saved data by touching the  button from the Main Screen. You may sort the list by Pile (file) Name, Date, Size or Directory (folder), by touching the corresponding column heading. Touching any file name will highlight it, then touching the Select File button will show a screen with the file name at the top, and buttons that allow you to Delete or Rename the file. Pressing Escape at any time on these screens will return to the previous one. If you have established an Internet or Dial Phone connection, or if you are in Standalone Mode, an additional Review Local or Review File button will be available. Touching it will take you to the Review Data Screen, which, similarly to the Collect Screen, will display the signals on the right side, with several viewing and editing functions available by touching the two rows of buttons at the bottom of the screen. NOTE: Some functions are only available if you are in Standalone Mode.

- Display Average or Individual Force and Velocity (see page 80)
- Browse Data (see page 81)
- Change Vertical Scale - Standalone Mode (see page 82)
- Time Scale (TS) - Standalone Mode (see page 83)
- Note or Comment - Standalone Mode (see page 84)

Please note that in Remote Mode (PDA-R) only average or individual force and velocity curves will be shown on the PAX. Other type of curves (Wave Up - Wave Down, Energy - Displacement, etc) can only be seen on the remote PDA-W program.

The files may also be backed up to an external memory source via the USB ports on the back of the PAX. To do this you will need to exit the program and use the Windows file explorer to locate and transfer your files onto a flash drive.

## Display Average or Individual Force and Velocity

This is accomplished by touching one of the two leftmost buttons on the first row of buttons underneath the graph.

For example, if you touch the 

button, the bottom row of buttons will appear like this:


appears with black background because the average velocity is currently being displayed.

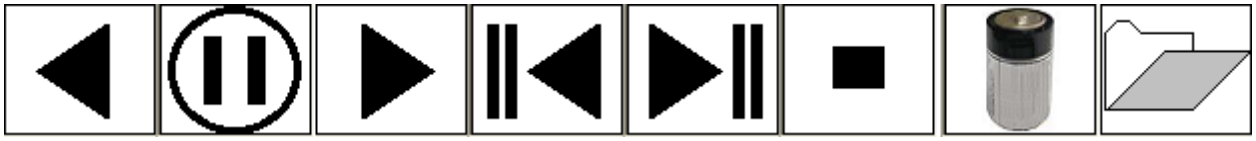
Touching for example the 

button only V1 will be displayed, and so on.

Changing the display from average force  to F1, F2, F3 or F4 works in a similar manner.

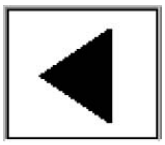
## Browsing Saved Data

This function is accessed by touching the  button. The bottom row of buttons will then appear like this:

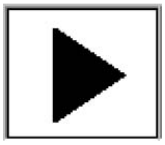


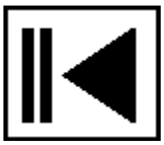
These two buttons at the left side of the screen are also used for browsing:

Touching the  button again will make the number at the bottom right change to 2, and the bottom row of buttons will then look like this:

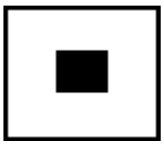

 Auto replay backwards.

 Pause auto replay.

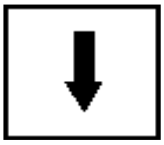
 Auto replay forward.


Jump to first record.

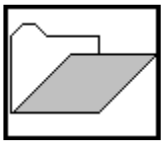

Jump to last record.


Small square = show every record
Medium square = show every three records
Big square = show every six records.


Move to next record.


Move to previous record.


Batteries status (see page 34)

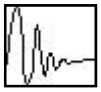

Select another file for reviewing


Set replay timer for auto replay.

Jump to Save Location.

## Changing Vertical Scale

*Only available in Standalone Mode.*

This is accomplished by touching the  button. The lower row of buttons will then show:

Scale automatically adjusted to give generally acceptable and normal force signals (Autoscale).

Decrease scale (expand graph vertically).

Increase scale (contract graph vertically).

## Adjusting Time Scale (TS)

*Only available in Standalone Mode.*

This is accomplished by touching the 

button on the first row of buttons underneath the graph. The bottom row of buttons will then appear like this:


Decreases time scale TS (expands graph horizontally).


Increases time scale TS (contracts graph horizontally).


Shifts the whole curve left by increasing TB (Time of Beginning).


Shifts the whole curve right by decreasing TB (Time of Beginning).


Allows manual adjust of the Time of Beginning.

## Adding a Note

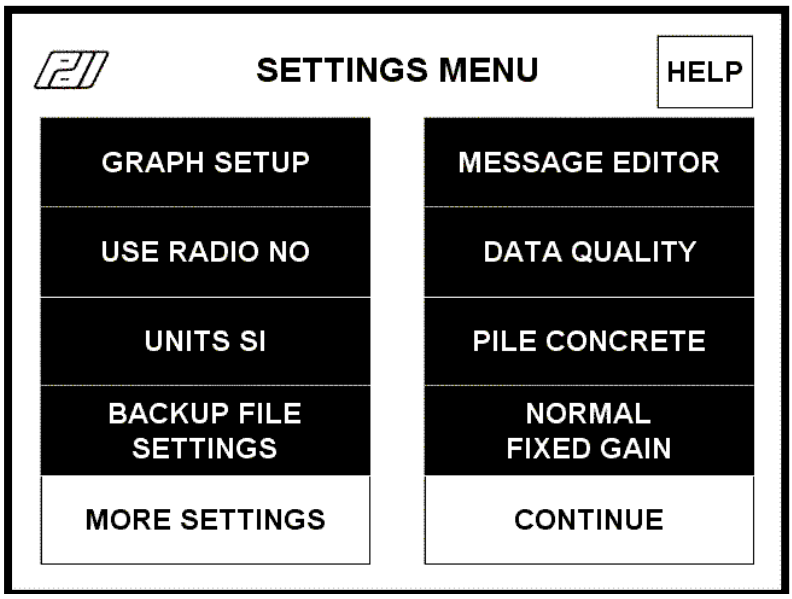
*Only available in Standalone Mode.*

Touching the 

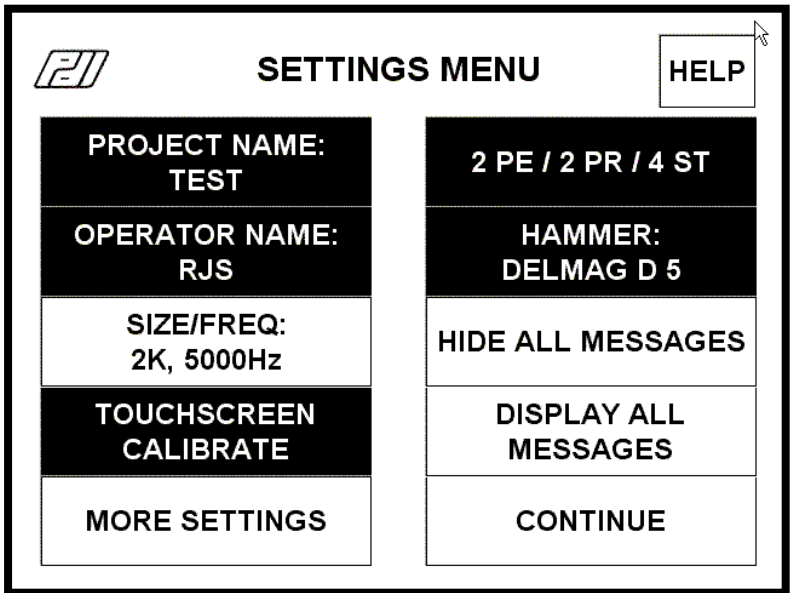
button (sixth from left to right) allows adding a note or a comment to the current record.

# Changing Settings

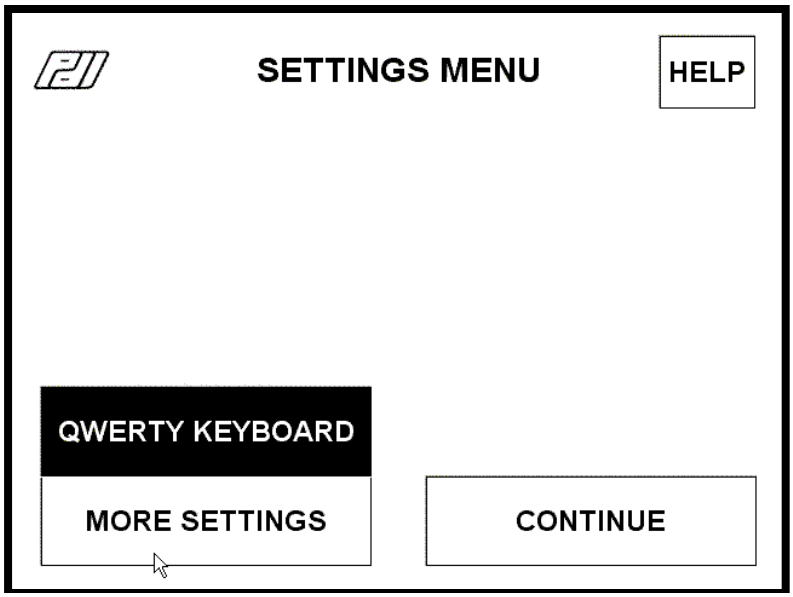
From the Main Menu (see page 62), touch the SETTINGS button. This will take you to the SETTINGS MENU shown below.




Touch MORE SETTINGS for the additional menu shown next, or touch CONTINUE when you are done. Buttons with a black background represent settings that were not changed.




Touch MORE SETTINGS again for the additional menu shown next or touch CONTINUE when done.




Below is a list of the settings that can be changed:

**GRAPH SETUP:** Allows changing the colors and styles of graph lines. It also allows turning the Axes, BETA, T1/T2 and Impact lines on or off.

**USE RADIO NO**: Use Wireless Gages – Toggles between NO, YES MANUALLY CONNECT and YES AUTO CONNECT (see page 47). Not available on all models.

**UNITS SI:** Toggles the unit system between SI, English and Metric.

**BACKUP FILE SETTINGS**: The PAX automatically saves a "squeezed" backup of every data set for thirty days in the PDIDataBackup directory. The first and last 40 records of the collected data are always saved. Touching this button opens up a screen that allows changing the frequency with which data will be saved between the first and last 40 records. Example: a Save Frequency of 10 (default) means every $10^{th}$ record will be saved between the first and last 40 records.

**MESSAGE EDITOR:** Allows editing custom messages like "Are you ready?", etc.

**DATA QUALITY**: Allows changing the thresholds for showing warning messages for out of range Velocity End and Maximum and Minimum Final Displacement.

**PILE CONCRETE:** Toggles the foundation material between Steel, Concrete and Timber. For composite or non-uniform foundations choose the predominant type of material at the gages location.

**NORMAL FIXED GAIN:** Allows changing the Test Mode and Gain setting (see page 42).

Touch MORE SETTINGS to access the buttons below:

**PROJECT NAME: TEST:** Allows editing the Project Name (PN on PDA-W).

**OPERATOR NAME: RJS:** Allows editing the Operator Name (OP on PDA-W).

**SIZE/FREQ: 2K, 10000Hz:** Allows changing the number of samples recorded for each signal and the sampling frequency. A list of recommended sample size/frequency combination will be shown. The user can use this or any other combination, having in mind that the larger the number of samples, the longer it takes to transmit data for each blow. Also, for a given sample size, the larger the frequency the smaller the total time - for most applications a total time of at least 204.8 ms is recommended. NOTE: this setting cannot be changed after a connection with the PDA-W has been established; you have to disconnect first in order to be able to make any changes.

**TOUCHSCREEN CALIBRATE:** Starts a Calibrate Touch Screen (see page 40) routine.

**2 PE / 2 PR / 4 ST:** Allows changing the number and type of transducers that will be used. The available options depend on the particular PAX model - 8 or 4 channels PE (piezo-electric) or PR (piezoresistive) accelerometers. NOTE: this setting cannot be changed after a connection with the PDA-W is established; you have to disconnect first in order to be able to make any changes.

**HAMMER: DELMAG D 5:** Allows entering Hammer Information in standalone mode (similar to the Hammer Tab on PDA-L - see page 14)

**HIDE ALL MESSAGES**: Hides all messages that have a check box "Do not display this message in the future".

**DISPLAY ALL MESSAGES**: Turn back on all messages that were previously hidden.

**QWERTY KEYBOARD**: Toggles between QWERTY (computer-like) and ALPHA keyboard. This affects all alphanumeric keyboards.

# Appendices

# Appendix A

## Pile Preparation and Sensor Attachment

The sensors should be bolted on diametrically opposite sides of the pile, a minimum of 1.5 times the pile diameter below the top, and equidistant about the neutral axis to minimize the effects of eccentric impacts or high local stresses. Attaching the sensors 2 or even 3 to 4 pile diameters below the top is preferable when the final pile length above grade allows - except for regularly reinforced concrete where attaching closer to the top is preferred due to normal minor tension cracking.

For restrikes the sensors may be attached at any convenient location above ground level, provided that a minimum distance of 1.5 times the pile diameter is allowed between its top and the sensors.

See Figures A through E on the following pages for recommended sensor bolt arrangements for different kinds of piles.

Fit the drill with the proper type and size bit and drill attachment holes in pile. All sensors made by Pile Dynamics, use ¼-20 or 6 mm bolts. Strain transducer holes are 3 inches (76 mm) apart. Do not drill holes while standing in the leads.

- With STEEL piles, drill 1/8" pilot holes for sensors. For pipe piles, drill holes with 7/32" bit and tap. If for H-piles, use 5/16" clearance holes.
- With CONCRETE piles, anchors are required. Drill holes with a hammer drill and 3/8" masonry bits. For the strain transducers, drill the first hole then install a threaded anchor firmly, attach the drill template and *then* drill the second hole.
- With TIMBER piles, drill with $^{1}/_{8}$" bit and attach sensors with lag bolts.

The sensor and connection cable wires are delicate, and cannot withstand the weight of the main cable. Therefore, if the sensors are installed high above ground support the main cable on a suitable location close to the pile top to relieve tension at the connections. This often requires drilling an additional hole for cable support. Do not attach the cable to the hammer leads or to the hammer.

Attach sensors with proper type, size and length HIGH STRENGTH bolts. If the bolt is too loose, the sensor may slip. Regular flat washers prevent scour of the sensors (avoid lock washers). To prevent damage, attach sensors and use sensor protectors if attaching before lifting the pile, or attach sensors to pile after the pile is placed in the hammer leads. If the sensors are placed too high above ground, they should be attached by the piling crew.

Attach the sensors to the connection cable which is then connected to the 19-pin connector on the main cable.

If wireless gages (see page 47) are being used, it is recommended that separate holes are drilled for supporting the radio transmitters (a single hole is sufficient for H piles). It is also possible for the transmitter to be supported by the accelerometer bolt, by inserting the radio transmitter metal plate between the head of the bolt and the accelerometer. This latter solution, however, may cause the accelerometer not to balance correctly, in which case it should not be used.

Use a flat washer with every bolt (lock washers should be avoided). It is a good idea to note the location of each strain transducer when attaching it to the pile, to help determining which side is receiving the higher stress, if the hammer is impacting eccentrically.

For H piles, sensors may be attached to the pile web prior to lifting the pile for driving. The accelerometers and one strain sensor may be mounted on one side with the cable, and the other strain sensor on the opposite side of the web with its cable passed through a flame cut hole in the web so the cable is not exposed.

For driven concrete and steel piles you may use "sensor protectors" which are placed over the sensors and secured with a belt strap so the sensors can be attached on the ground, as opposed to after the pile is already lifted. The sensor protectors keep the sensors from being damaged in the lifting process and in many cases eliminate the need to climb the leads. They also allow the engineer to personally assure the attachment of sensors rather than relying on the pile crew members.

For drilled and cast-in-place shafts, the guidelines below should be followed:

1) If a permanent casing is not used as a feature to construct the test shaft, then a shaft top extension, consisting of a thin walled casing or equivalent, shall be used to extend the test shaft by a length ideally equal to two diameters (note: on large piles where it is impractical to use two diameters, an absolutely minimum distance of one diameter may be accepted). Windows on possibly four opposite sides of the test shaft may have to be cut off in the steel casing to reach the concrete. Alternatively, an entire band of the casing can be removed to expose a smooth concrete surface for attachment of the sensors.
2) The top of the extension has to be flat, level and axial to the test shaft. Concrete should be level with, or above the casing.
3) A drop weight in the range of one to two percent (1 - 2%) of the anticipated test shaft ultimate capacity has to be used. The impacting surface of the drop weight should have an area between 70 and 130% of the test shaft top area. The shape of the ram weight should be as regular as possible (square, round, hexagonal, etc).
4) The drop weight should have a guide system allowing variable drop heights typically between 3 and 7 ft (1 to 2 m).
5) A top cushion consisting of new sheets of plywood with total thickness between 2 to 6 inches (50 to 150 mm) should be used.
6) If protruding reinforcing bars are present, it can be incorporated to the reinforcing steel in the extension area. Upon successful completion of the dynamic test, the surrounding concrete can then be removed so as to make the foundation suitable for use in the structure. Alternatively, a steel beam or pipe (with a cross sectional area approximately 20% of the shaft cross-sectional area) shall be supplied with sufficient length such that the ram impact will not interfere with the reinforcing bars. The plywood cushion must also be sized so that it covers as much of the impact area as possible.

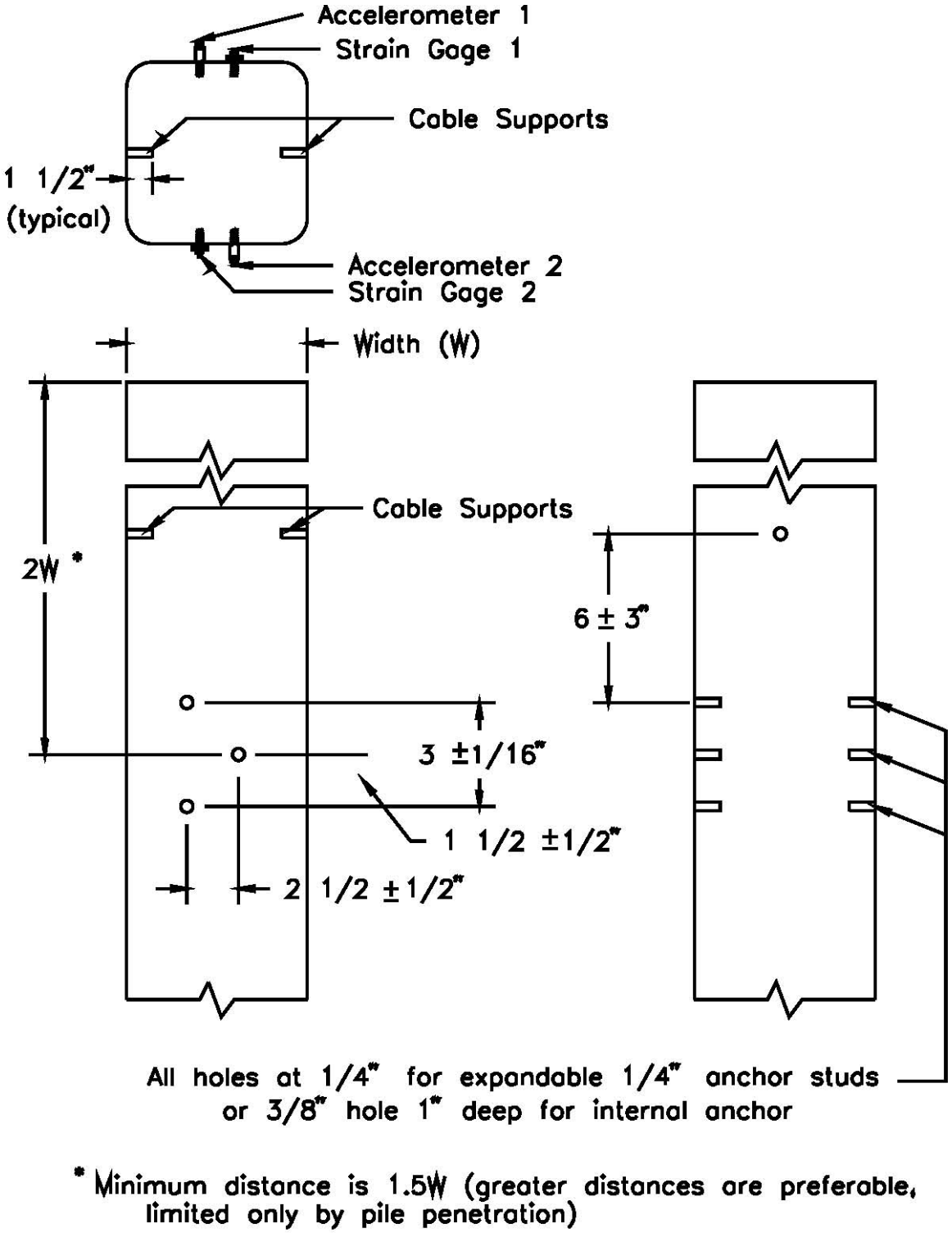



Figure A: Sensors bolt arrangement for concrete piles

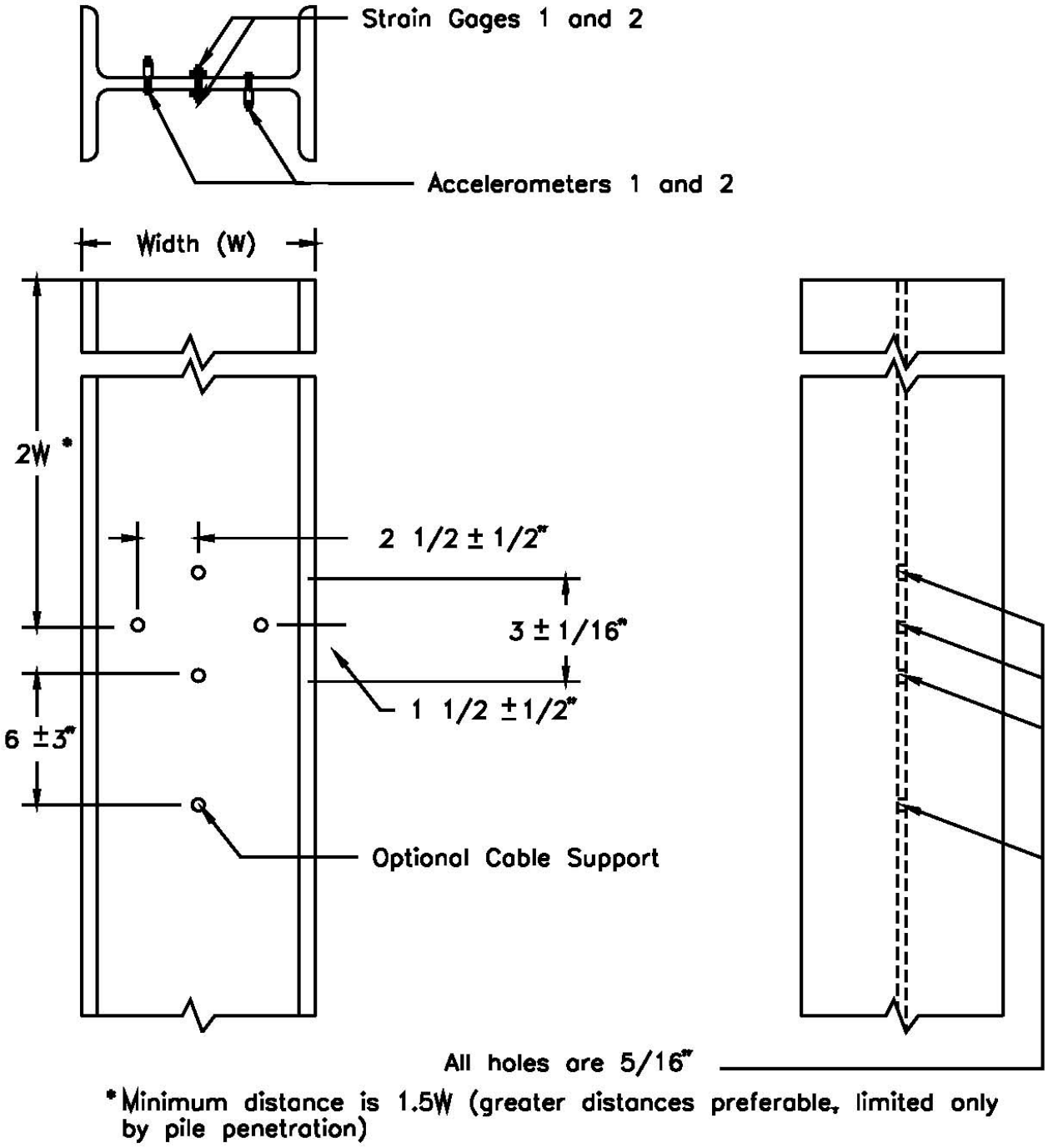



Figure B: Sensors bolt arrangement for H-piles

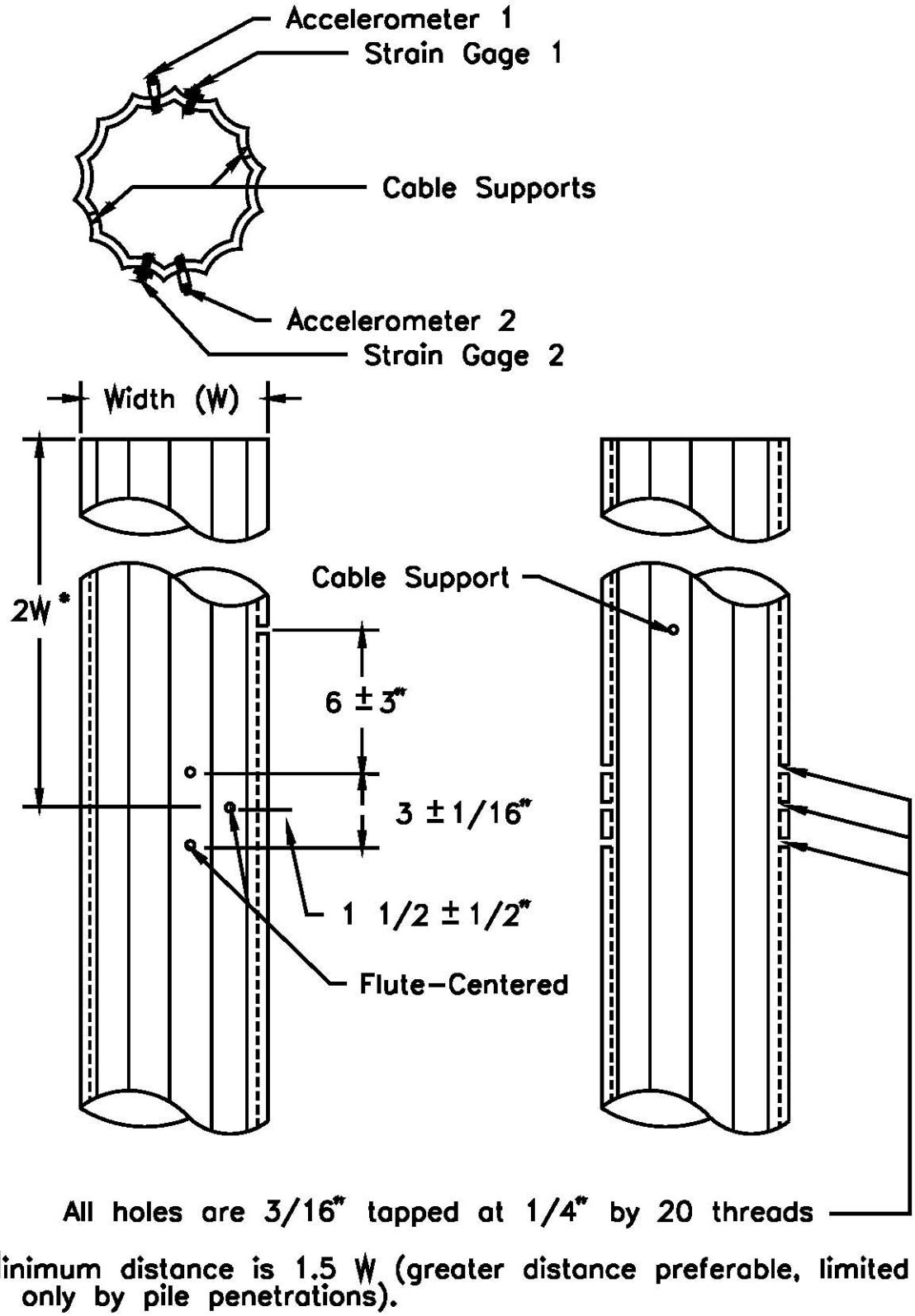



Figure C: Sensors bolt arrangements for monotube piles

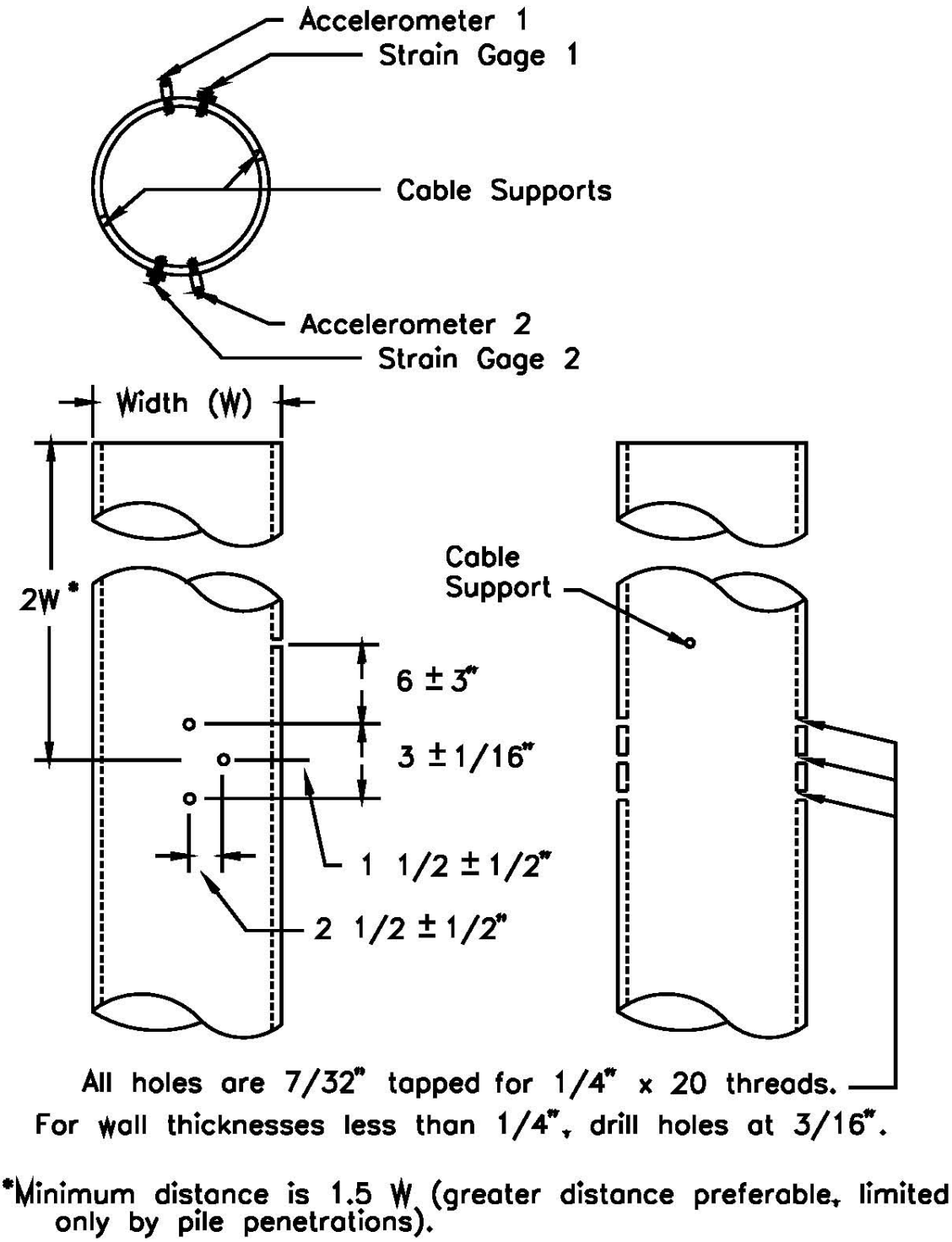



Figure D: Sensors bolt arrangement for pipe piles

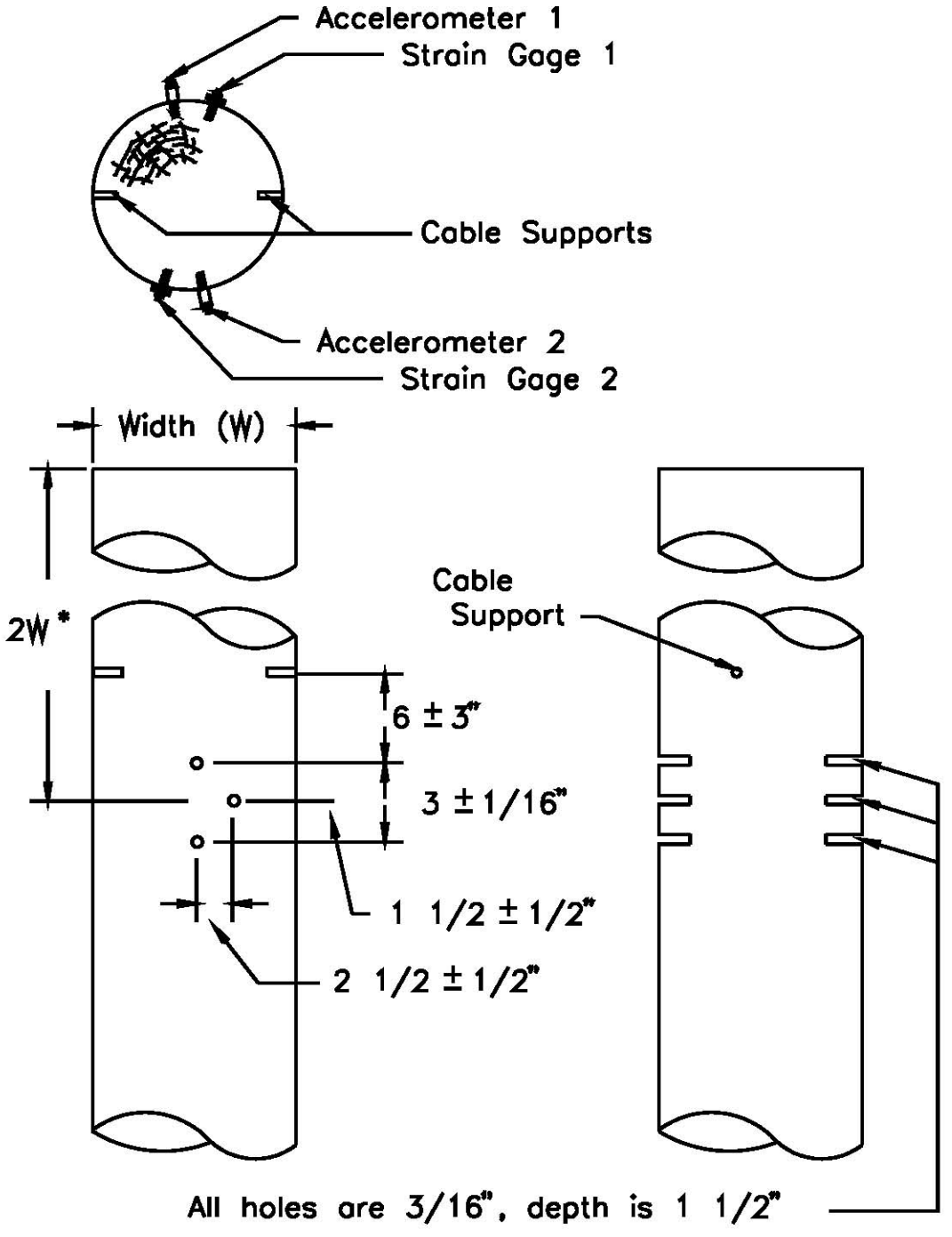



Figure E: Sensors bolt arrangement for timber piles

# Appendix B

## Using the PDA for measuring energy on SPT rods

One additional application of the Pile Driving Analyzer is measuring the energy transferred to an SPT rod during impact, as specified on ASTM D 4633-05 and other codes. Pile Dynamics manufactures the SPT Analyzer, which is a device specifically designed only for this purpose. However, any model PDA except the PAX 4-PE can also be used for this type of measurement.

In order to measure the energy it is necessary to use an instrumented rod, rather than the strain transducers used on foundation elements. The instrumented rod consists of a 0.6 m (24 inches) long sub-assembly of an SPT rod (AW, NW or other type), to which two strain gage bridges have been glued and calibrated by Pile Dynamics. The calibration factors for the two strain gage bridges and the cross section area of the rod are printed on labels attached to the rod supplied by Pile Dynamics. Each bridge has full bending compensation, so having two provides a backup, but also gives assurance of the correctness of the measurement since proportionality for SPT cannot be assured in some cases. Each strain gage bridge connects to a twist-lock plug, just like a standard strain transducer. Two standard piezoresistive (PR) accelerometers are bolted to the rod, and all sensors are connected to the PDA main cable using the regular PR connection cable used for measurements taken on foundations. PR accelerometers are required for SPT testing (PE data is generally of no use due to high resonant frequencies from the steel-to-steel impacts).

The accelerometers should first be attached to the SPT rod, and all accelerometers and strain bridges should be connected to the connection cable. Next the instrumented rod should be attached to the top of the drill string, and the hammer assembly attached to the top of the instrumented subassembly. Finally the main cable should be connected to the connection cable; this should be done last so that the cables do not become twisted as the rod is spun and joints are tightened.

After acquiring the data for one depth increment, the PDA is placed in PAUSE and the main cable is disconnected at the connection cable prior to removal of the instrumented section, another non-instrumented section is inserted as the soil boring investigation advances to the next depth, and the instrumented section is reattached to the top of the drive rod and the cable connected. This procedure is repeated until the hole is completed and testing concluded.

It is recommended that a higher sampling frequency be used with SPT rods. For the PAX a 40 KHz sampling frequency with a 4 Kbytes record size can be selected. This guarantees a total record duration of about 100 ms, which should be sufficient for most applications.

A Custom Hammer should be entered with the appropriate ram weight (e.g. 0.6235 kN or 0.14 kips for the standard hammers) and energy (e.g. the standard 0.476 kN-m or 0.35 kip-ft). It is also very important to enter the correct cross sectional area, elastic modulus and calibration constants as printed on the label attached to the instrumented rod. The LE value, although not essential for accurate energy values, should be the length from the middle of the strain transducers to the bottom of the sampler.

The objective of the test is to measure ETR, that is, the ratio of the measured energy transferred to the rod (EFV or EMX) to the theoretical potential energy. The usual procedure as described in

ASTM 4633-05 and other codes is to calculate an average ETR for all consistent hammer blow data recorded during the testing of several depth increments with different rod lengths and N-values; this average number is then used to correct the N values measured using this particular rig.

While capacity values like RMX are of lesser importance and sometimes incorrect if the rod is strongly non-uniform, other measurement results like FMX (maximum force), CSX (compressive stress), VMX (maximum velocity), BPM (blows per minute), etc. are valid and potentially valuable information for the report. The EF2 value is sometimes a required result. It calculates the transferred energy in an approximate manner from the square of the force measurement. It is important to realize that this value is fraught with uncertainties and requires thorough analysis and far reaching corrections and is, therefore, not recommended as standard output.

The PDIPLOT program can be used with data from the PDA in order to plot and list the measured values, and to calculate averages, standard deviations, maxima and minima. It is also possible to use the PDA-W program to generate a text file containing the quantity values for all recorded blows, by clicking on "File" and choosing "Save SW File (Win)…". This text file can then be imported into a spreadsheet for further processing.

**Testing Precautions:**

(1) When tightening the connection between instrumented rod and drive rod, care has to be exercised not to damage the strain gages, accelerometers and their cables.

(2) Be sure that the accelerometer bolts stay well tightened during the test or no meaningful results will be obtained. For drill rigs with particularly high frequency/high g-level accelerations bolts may loosen during testing. In that case special precautions such as lock washers or a liquid locking compound (e.g., Locktite) may be helpful. Note: the use of lock washers or liquid locking compound is not recommended for other kinds of PDA tests.

(3) Be sure that the individual rod sections are connected and that they are well tightened. Although the EMX calculation of energy, based on the integration of the product of force and velocity over time, is correct, loose connectors make the evaluation of data quality more difficult.

(4) It is important that the testing proceeds in a standard manner and that no modifications are made to the equipment and that the SPT crew performs their work in a normal fashion. Record the serial number of the equipment and the name of the operator. Report any unusual occurrences.

(5) After the records for each section have been acquired, compare the traces of the individual sensors, e.g. F3 with F4 and the velocity from A3 with that from A4. These signals should be tracking each other closely; if they do not appear to be very similar a measurement error may have occurred which would require further checking and possibly some sensor exchange before the next testing sequence is performed.

# Appendix C

## Maintenance and Troubleshooting

### Calibration check

In order to check the PAX internal calibration, proceed as follows:

Set all the accelerometer calibrations to 100. Set all the force calibrations to 147.5. Generate a Calibration Signal as described on page 21. The calibration accuracy of the PDA signal conditioning can be evaluated by looking at the maximum velocity (VMX) which checks both the accelerometer calibration and the integration process, and by looking at the maximum strain (MEX). The (dimensionless) maximum strain MEX is independent of units and independent of pile properties. You should get the following results:

| | English | SI or Metric | Tolerance |
|---|---|---|---|
| MEX | 737.5 | 737.5 | +/- 2% |
| VMX (PE acc.) | 13.4 | 4.09 | +/- 2% |

*Important*: The above procedure will only check the accuracy of the strain gages and piezoelectric (PE) accelerometer circuits. The calibration signal can still be used for testing the functionality of the Piezoresistive (PR) accelerometer circuits, but not their accuracy. This can only be checked using an external calibration box (available from Pile Dynamics, Inc.). The results of the calibration test procedure using the external calibration box are as follows:

| | English | SI or Metric | Tolerance |
|---|---|---|---|
| MEX | 737.5 | 737.5 | +/- 2% |
| VMX (PE acc.) | 13.4 | 4.09 | +/- 2% |
| VMX (PR acc.) | 13.8 | 4.21 | +/- 2% |

If the results are outside of the acceptable range, the unit has to be sent to Pile Dynamics for calibration.

### Data Quality Check

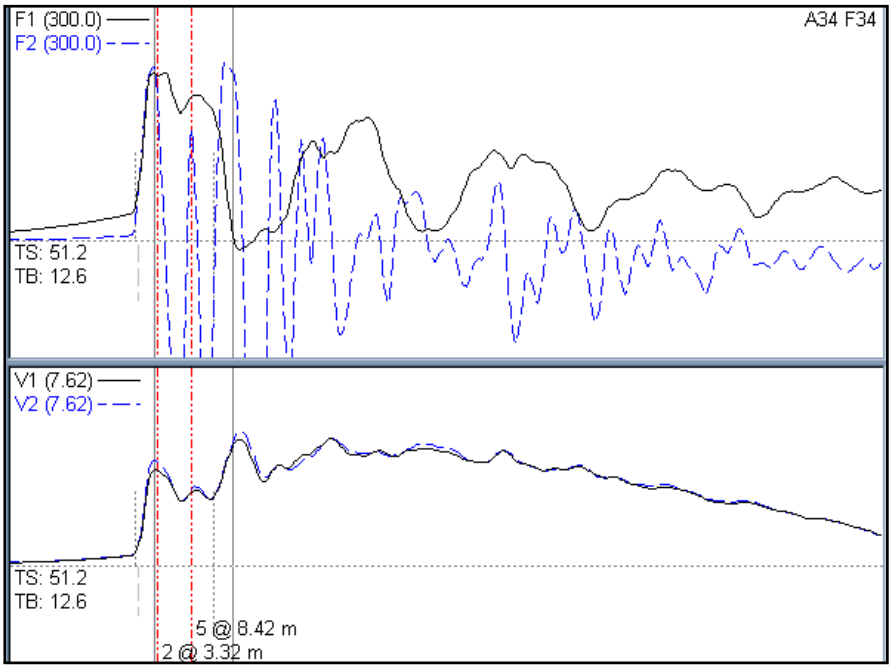
THE PDA OPERATOR SHOULD ALWAYS CHECK DATA QUALITY FOR CONSISTENCY AND PROPORTIONALITY (EQUAL AVERAGE FORCE AND VELOCITY IN THE BEGINNING OF THE RECORD) AND REVIEW WARNINGS. Comparing the velocity signals (choose Vi on Display Mode, see page 24) verifies accelerometer performance - good data gives similar velocity for each sensor, gives reasonable displacement versus time (choose D, E on Display Mode) and is consistent blow after blow while bad data is not repetitive. Strain sensors will also give repetitive data from blow to blow, but the two strain sensors (or 4 if in 8 channel) will often not be similar due to bending.

Usually a problem is due to a bad sensor or bad cable. If problems are suspected, check or replace sensors, connection cable and/or main cable. If necessary, the PDA will work with only

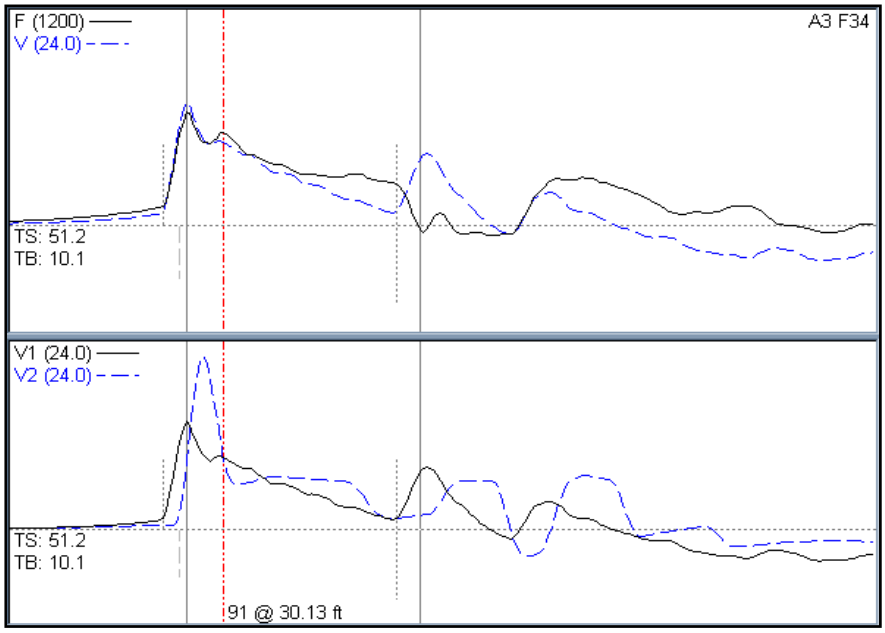
one accelerometer. Make sure to turn the bad accelerometer OFF (see page 30), otherwise the average velocity will be wrong, and the average force and velocity signal will not be proportional.

Below are some examples of unacceptable data and possible remedies:

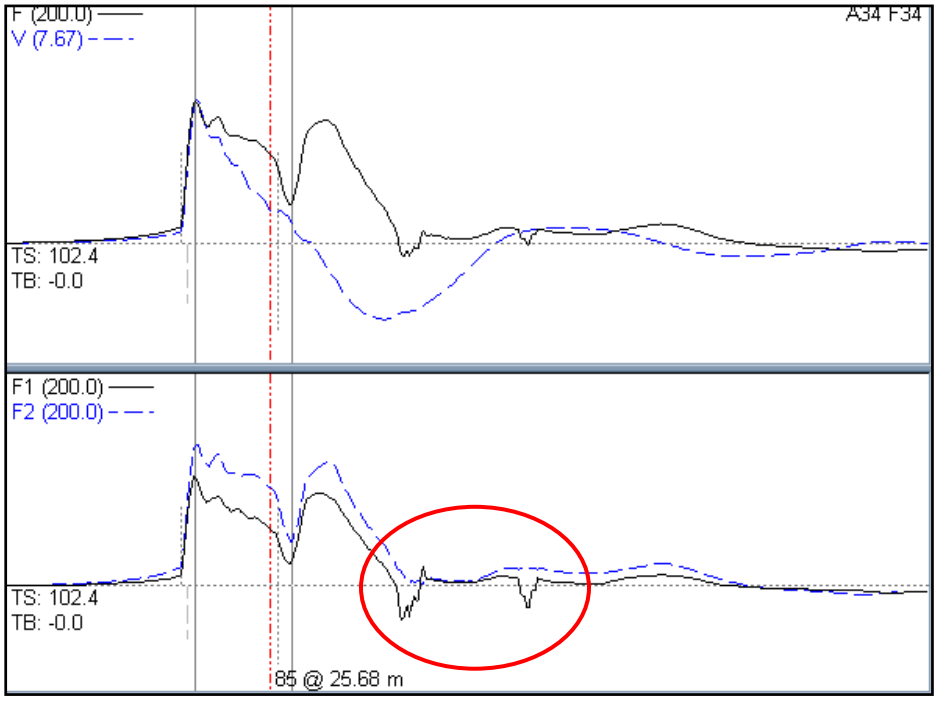
- Loose F2 strain transducer – stop the test immediately and retighten



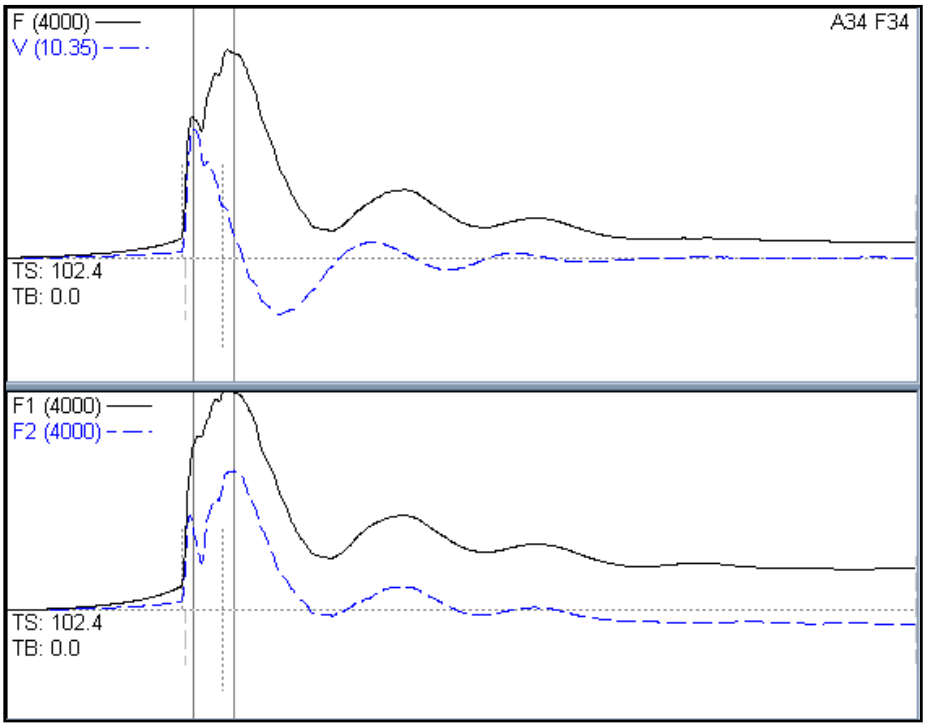

- Loose V2 accelerometer – turn it off (see page 30) and retighten as soon as possible



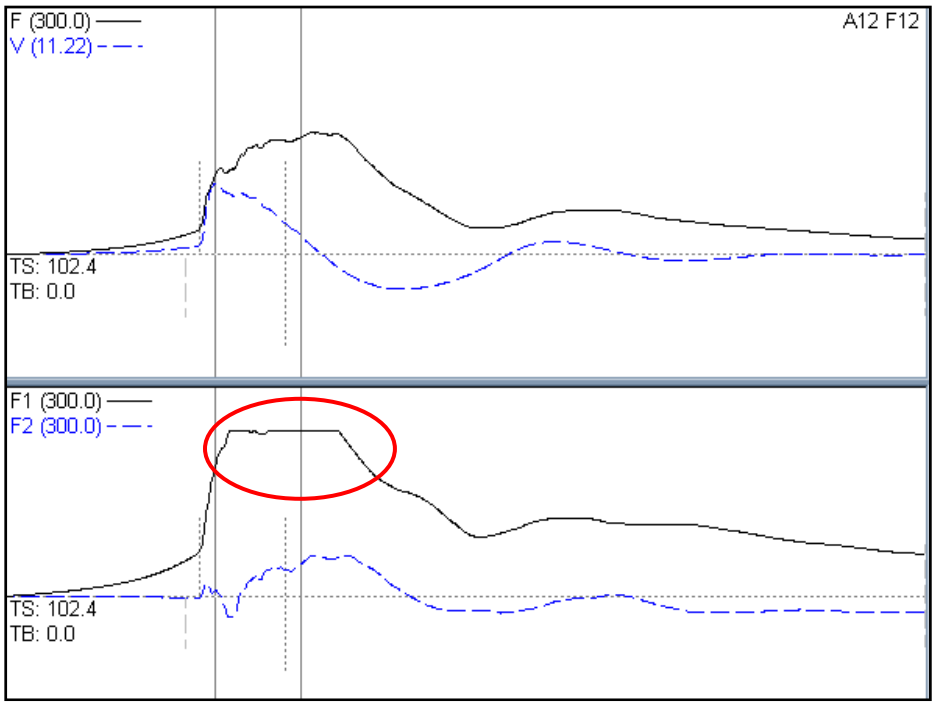
- F1 strain has "spike", caused by sensor or cable failure – replace connector cable or sensor until problem disappears; send defective cable or sensor to Pile Dynamics for repair.




- F1 strain does not return to zero at the end of the record – pile material is probably yielding due to high stresses; check hammer alignment and reduce energy.



- F1 strain is "clipping" – check off-set (see Balancing Gages on page 18), check hammer alignment, reduce energy



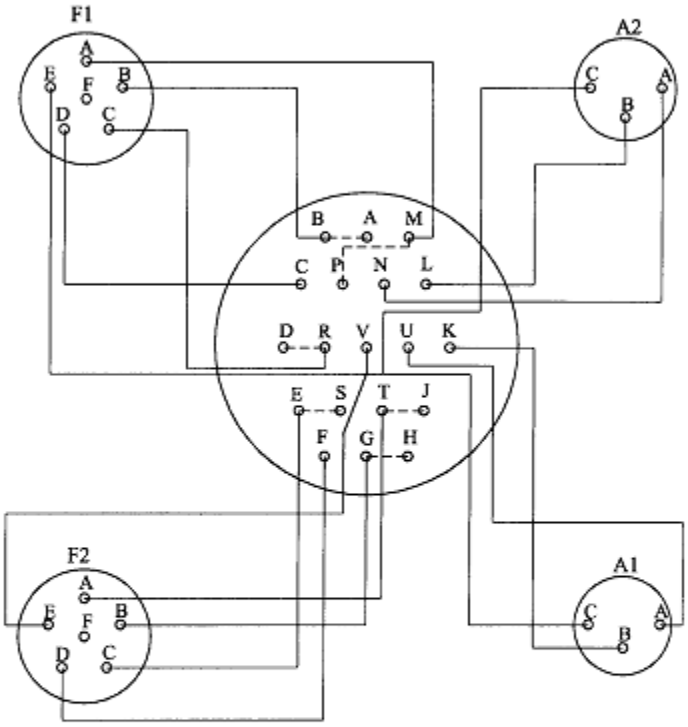

## Some problems and possible causes

| | |
|---|---|
| No signal displayed upon hammer impact, although calibration signal indicates that all cables and sensors are OK | • Check if PAX is in accept mode (see page 20 for Local Mode or page 75 for Remote Mode)<br>• Make sure that all sensors are tightly attached to the pile, especially those connected to the trigger channel(s)<br>• Make sure sensors and connectors are not submerged<br>• Reduce the trigger level (see page 16); note: if your unit does not allow adjusting the trigger level, please contact Pile Dynamics, Inc. for an update |
| "False triggering", that is, the unit is recording signals even when no blow is being applied | • Check cables and connections<br>• Increase the trigger level (see page 16) |
| Signal not proportional (force is below or above the force in the beginning of the record) | • Check the signals from all sensors (view individual force and velocity records, see page 24); if any individual signal is zero, for example because the sensor is loose or because of bad connection, the average force or velocity will be wrong. If a velocity |

| | |
|---|---|
| | signal is zero, turn it off (see page 30). If a force signal is zero, replace the sensor and/or cable.<br>• Check if any sensor is not aligned with the pile – you can use a replay factor to correct if necessary – see page 29.<br>• Change wave speed (only for concrete or timber piles); increase wave speed if force is consistently below the velocity, or decrease wave speed if force is above velocity. |

# Appendix D
## Diagrams

PE TWIST LOCK CONNECTION CABLE




MAIN CABLE

| | | |
|---|---|---|
| -B | F1- EXC | RED |
| -P | F1+ EXC | BLACK |
| -A | F1 - SEN | BLACK |
| -M | F1 + SEN | GREEN |
| C | F1 + SIG | BLUE |
| R | F1 - SIG | BLACK |
| D | F1 SHUNT | BLACK |
| E | F2 SHUNT | YELLOW |
| G | F2 - EXC | BLACK |
| T | F2 + EXC | ORANGE |
| J | F2 + SEN | RED |
| H | F2 - SEN | WHITE |
| F | F2 + SIG | BLACK |
| S | F2 - SIG | BROWN |
| U | +A1 | GREEN |
| K | -A1 | RED |
| N | +A2 | WHITE |
| L | -A2 | BLACK |
| -V | SHIELD | |

F1/F2

| | | |
|---|---|---|
| A | + EXC | BLACK |
| B | - EXC | GREEN |
| C | - SIG | WHITE |
| D | + SIG | RED |
| E | SHIELD | |
| F | N/C | |

19 PIN MALE W/ RING
STRAIGHT PLUG
851- 06JC-1419- P50

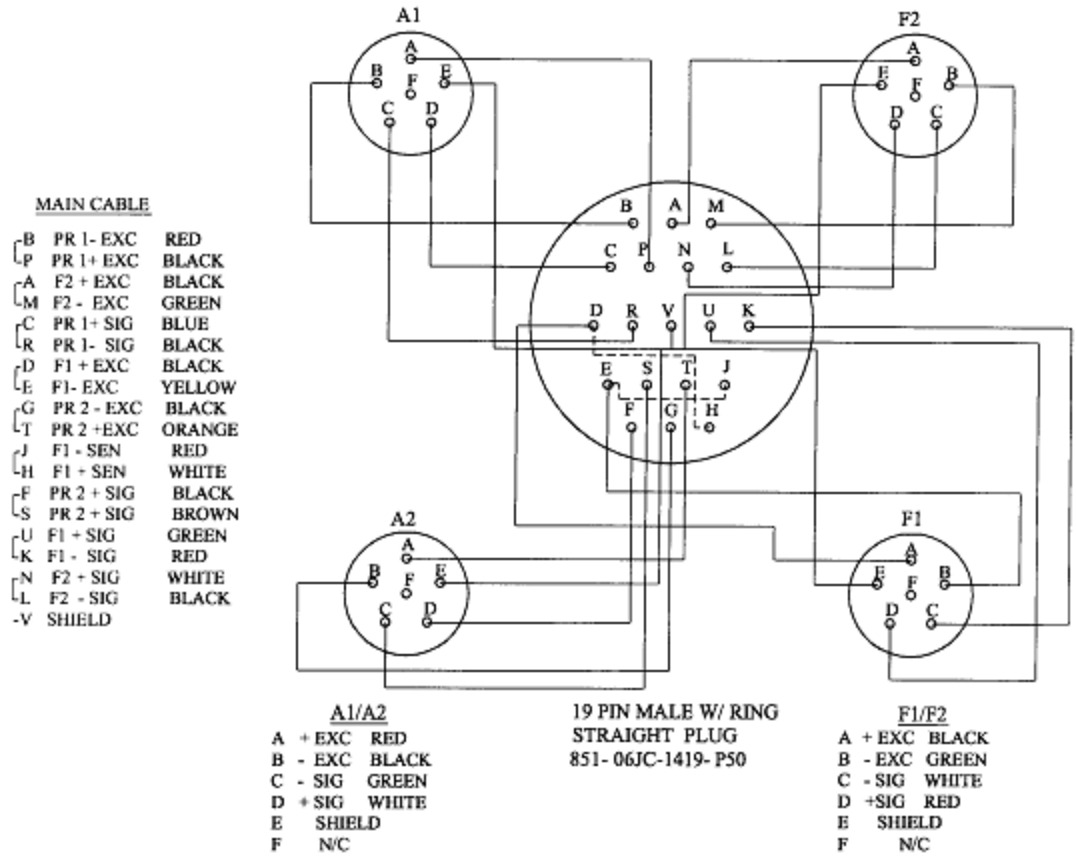
A1/A2

| | | |
|---|---|---|
| A | + A SIG | RED |
| B | - A SIG | BLACK |
| C | SHIELD - SIG | WHITE |

6 PIN FEMALE RECEPTACLE
851-01JC-1098-S50
NO RING
F1/F2 - 21" LONG

3 PIN FEMALE RECEPTACLE
851-01JC-8E-S50
NO RING
A1/A2- 19" LONG

## PR TWIST LOCK CONNECTION CABLE




Note: to check the strain bridge, use a DVM multimeter on the ohms scale; 262 or 350 ohms between combination of pins A through D are correct.

# Appendix E

## Specifications

**Physical:**
Size: 150 X 220 X 290 mm (5.9 x 8.7 x 11.4 inches)
Weight: 5 Kg (11 lbs)
Temperature range: 0 to 40°C (32 to 104º F) operating; -20 to 65°C (-4 to 149 °F) storage
High visibility color VGA backlit LCD display optically enhanced for outdoor viewing
High contrast touch screen doubles as keyboard
Built in VGA external monitor port
Power: built-in 6 hour duration battery, 12 VDC car battery, or 100-240 VAC w/12 VDC converter
Fast charger recharges built-in battery in 4 hours
**Electronic:**
PC compatible processor, running Microsoft Windows XP Home Edition
40 GB hard disk minimum
512 KB DRAM minimum
Ethernet port
2 USB ports
Analog signal frequency response 5 KHZ (-3 dB)
24-bit A/D converter with sampling frequency of 5.12 MHz
8 channels with effective digitizing frequency of 40 KHZ per channel (2500 – 40000 HZ selectable)
Resolution: 24 bit A/D
Transducer signals digitally recorded
1Kbyte, 2Kbyte, or 4Kbyte data record sizes available
Built in calibration test function
Basic unit accuracy 2%
**Functional:**
Two or four channels of strain data acquisition
Two or four channels of acceleration data acquisition
Automatic balancing of signals and signal conditioning
Signal conditioning for force and acceleration have similar frequency response
Internal calibration check of strain and acceleration
Signal amplification capability
Automatically triggers on any attached strain transducers
High speed internet data transmission through broadband phone or other network device
Dial up data transmission through data capable mobile phone connected via USB
**Other:**
Optional external USB keyboard, mouse, memory stick, and WiFi (802.11x) available
Operates in English, SI, or Metric units
Includes both soft side carry-on luggage case and hard transit case

# Appendix F

## About Internet Connections

See also: Finding the IP Address page A-**Error! Bookmark not defined.**.

Digital information travels through a network in packets, whose formats are defined by the Protocol used by that particular network. In order for the information to reach the correct device on a computer network using the Internet Protocol (IP), those packets use identifiers called IP addresses. Each IP address is a code composed of four groups of up to three digits, separated by dots. It uniquely identifies any particular device on the network. For our purposes, we can separate networks in three categories:

- LAN - Local Area Network, is a network connecting the devices in one office or one home. Computers or other devices within this office or home can communicate with each other, but they cannot directly communicate with computers connected to other LAN's. When a device is logged on to this network it is assigned an IP address, either manually (by user configuration, for example) or automatically using a Dynamic Host Configuration Protocol (DHCP) server, which assigns an IP address at random, or based on a predetermined policy. A group of IP addresses are set aside for these private networks. Note that it is possible for two devices to have the same LAN IP address at the same time, provided that they are connected to different LAN's.

- WAN - Wide Area Network, refers to the Internet. Computers or other devices usually connect to this worldwide network using an Internet Service Provider (ISP). When the connection is established, the ISP will provide an IP address to the computer. This IP address can be static, that is, will always be the same for that particular computer, or dynamic, that is, may change each time the computer establishes a new connection with the ISP. Dynamic addresses are more common, since static addresses usually imply the user having to pay an additional fee to the ISP. These public IP addresses are managed by the Internet Assigned Numbers Authority (IANA). IANA generally allocates super-blocks of addresses to Regional Internet Registries, who in turn allocate smaller blocks to Internet Service Providers and enterprises. This way it is assured that whenever a computer is directly connected to the Internet it has a unique IP number.

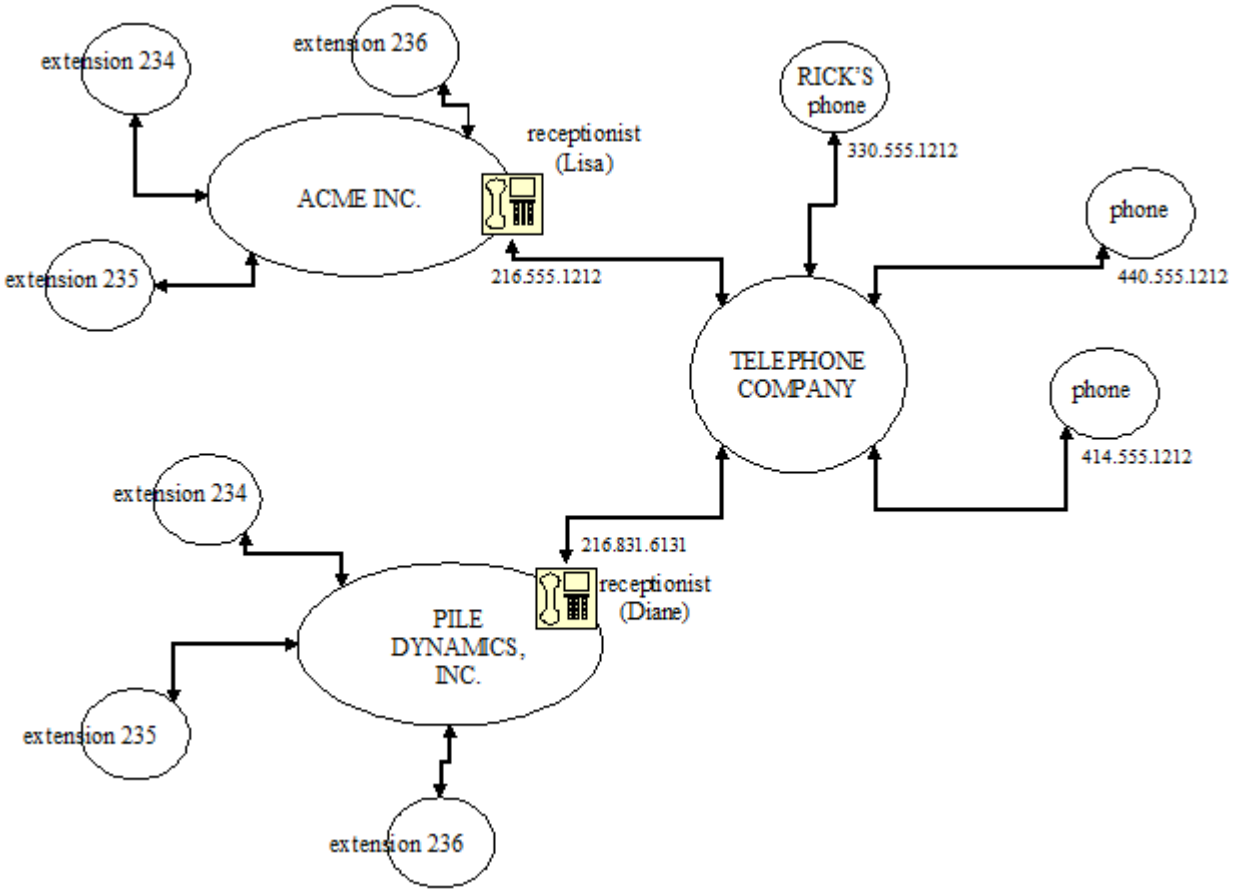
- WWAN - Wireless Wide Area Network - works similarly to a WAN.

In order to allow multiple devices on a LAN to access the Internet using a single public IP address, a process called Network Address Translation (NAT) is used. This allows you, for example, to connect your desktop and your laptop simultaneously to the Internet using one single access to the ISP. This process usually involves the use of routers or Internet Connection Sharing protocols.

If for example a particular computer is running the PDA-W program, it must be configured to receive the "data packets" that the PAX is sending to it through the Internet. The network to which the computer is connected not only needs to know that a given data packet is intended for that computer, but also needs to know that it should be directed to the PDA-W program, and not to the web browser or any other program that might be running on that computer. To accomplish it, a so-called "port number" is assigned to the PDA-W program. This port number is added to the header of a data packet, and theoretically can be any number in the range of 0 to 65535. Since the numbers from 0 to 1023 (the so-called "well known ports") are assigned to many standard applications (like your web browser, for example), they should not be used by the PDA-W program.

In other words, in order for a data packet sent from the PAX to correctly reach the remote computer running the PDA-W program, it has to address the computer's IP address and port number. If the computer running the PDA-W program is connected to a LAN or a router, it is necessary to set-up a process called **Port Forwarding** in order to convert the WAN IP address and port number into a LAN address and port number. Port Forwarding has to be set-up by your office IT department or by configuring your router or other Internet Connection Sharing device. It is not necessary if your computer has direct access to the Internet, like in the case of a single computer connected to the Internet through a cable or DSL modem.

The diagram below illustrates what has been explained so far:



On an Internet connection, it is important to distinguish between the CLIENT and the SERVER. When the connection process is initiated, the Client tries to contact the Server's IP address and port number. When the Client gets an answer the connection is established. It is therefore essential that the Client knows the Server's IP address and port number. The recommended configuration is for the PDA-W program to act as a Server and the PAX to act as a Client. In this case it is necessary to input the PDA-W's IP address and port number on the PAX (the Client), so that it knows how to find the remote PDA-W program (the Server).

## Glossary

**CLIENT/SERVER** "Client/server is network architecture which separates the client (often an application that uses a graphical user interface) from the server. Each instance of the client software can send requests to a server or application server. There are many different types of servers; some examples include: a file server, terminal server, or mail server. While their purpose varies somewhat, the basic architecture remains that same. . . .[T]he easiest example to visualize is the current use of web pages on the Internet. For example, [when] you are reading [an] article on Wikipedia, your computer and web browser would be considered a *client*, and the computers, databases, and applications that make up Wikipedia would be considered the *server*."[i]

**DYNAMIC IP ADDRESS** "Dynamic IP addresses are issued to identify non-permanent devices such as personal computers or clients. . . . This is used for dial-up access. . .allowing a. . . user to automatically connect to a variety of services without needing to know the addressing details of each network. . . . The most common protocol used to dynamically assign addresses is Dynamic Host Configuration Protocol (DHCP). DHCP includes a lease time which determines how long the requester can use an address before requesting its renewal, allowing addresses to be reclaimed if the requester goes offline. The DHCP server listens for requests and then assigns an address. System administrators may set the DHCP server so that it assigns addresses at ransom, or based on a predetermined policy."[ii]

**IP ADDRESS** "An IP address (Internet Protocal address) is a unique number that devices use in order to identify and communicate with each other on a computer network utilizing the Internet Protocol standard (IP). . . . [R]outers, computers, time-servers, printers, Internet fax machines, and some telephones . . . must have [their] own unique address. An IP address can also be thought of as the equivalent of a street address or a phone number . . . for a computer or other network device on the Internet. Just as each Street addess and phone number uniquely identifies a building or telephone, an IP address can uniquely identify a specific computer or other network device on a network."[iii]

**LAN – LOCAL AREA NETWORK** See also PRIVATE NETWORK "A local area network (LAN) is a computer network covering a local area, like a home, office, or group of buildings. Current LANs are most likely to be based on switched IEEE 802.3 Ethernet running at 10, 100 or 1,000 Mbit/s or on Wi-Fi technology . The defining characteristics of LANs in contrast to WANs (wide area networks) are: their much higher data rates; smaller geographic range; and that they do not require leased telecommunication lines."[iv]

**NETWORK ADDRESS TRANSLATION (NAT)** "In computer networking, the process of network address translation (NAT, also known as network masquerading or IP-masquerading) involves re-writing the source and/or destination addresses of IP packets as they pass through a router or firewall. Most systems using NAT do so in order to enable multiple hosts on a private network to access the Internet using a single public IP address. . . ."[v]

**PORT** . . . "[A] port is a special number. . . Ports are typically used to map data to a particular process running on a computer."[vi]
**PORT FORWARDING** "Port forwarding (sometimes referred to as tunneling) is the act of forwarding a network port form one network node to another. This technique can allow an external user to reach a port on a private IP address (inside a LAN) from the outside. . . ."[vii]
**PRIVATE NETWORK** "[A] private network is a network that uses a [defined] IP address space. Computers may be allocated addresses from this address space when it's necessary for them to communicate with other computing devices on an internal (non-Internet) network but not directly with the Internet. Private networks are becoming quite common in office local area network (LAN) designs, as many organizations do not see a need for globally unique IP addresses for every computer, printer and other device that the organizations use. Another reason for the extensive use of private IP addresses is the shortage of publicly registered IP addresses. . . . [T]he Internet is normally configured to discard any traffic using private IP addresses. . . . The current *private Internet* addresses are:"[viii]

| **IP address range** |
|---|
| 10.0.0.0 – 10.255.255.255 |
| 172.16.0.0 – 172.31.255.255 |
| 192.168.0.0 – 192.168.255.255 |
| 169.254.0.0 – 169.254.255.255 |

**STATIC IP ADDRESS** "Static IP addresses are used to identify semi-permanent devices with constant IP addresses."[ix]
**WAN – WIDE AREA NETWORK** "A wide area network is a computer network covering a broad geographical area. Contract with personal area networks (PANs), local area networks (LANs) or metropolitan area networks (MANs) that are usually limited to a room, building or campus. The largest and most well-known example of a WAN is the Internet. WANs are used to connect local area networks (LANs) together, so that users and computers in one location can communicate with users and computers in other locations. Many WANs are built for particular organization and are private. Others, built by Internet service providers, provide connections from an organization's LAN to the Internet. WANs are most often built using leased lines."[x]
**WWAN – WIRELESS WIDE AREA NETWORK** "WWAN, which stands for *Wireless Wide Area Network*, is a form of a wireless network. A WWAN differs from s WLAN (e.g. wireless LAN) since it uses cellular network technologies . . . to transfer data."[xi]

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[i] Wikipedia contributors, "Client-server," *Wikipedia, The Free Encyclopedia,* http://en.wikipedia.org/w/index.php?title=Client-server&oldid=83978758 (accessed October 27, 2006).
[ii] Wikipedia contributors, "IP address," *Wikipedia, The Free Encyclopedia,* http://en.wikipedia.org/w/index.php?title=IP_address&oldid=84616937 (accessed October 30, 2006).
[iii] Wikipedia contributors, "IP address," *Wikipedia, The Free Encyclopedia,* http://en.wikipedia.org/w/index.php?title=IP_address&oldid=84065227 (accessed October 27, 2006).
[iv] Wikipedia contributors, "Local area network," *Wikipedia, The Free Encyclopedia,* http://en.wikipedia.org/w/index.php?title=Local_area_network&oldid=83970048 (accessed October 27, 2006).
[v] Wikipedia contributors, "Network address translation," *Wikipedia, The Free Encyclopedia,* http://en.wikipedia.org/w/index.php?title=Network_address_translation&oldid=83670128 (accessed October 27, 2006).
[vi] Wikipedia contributors, "TCP and UDP port," *Wikipedia, The Free Encyclopedia,* http://en.wikipedia.org/w/index.php?title=TCP_and_UDP_port&oldid=83149017 (accessed October 27, 2006).
[vii] Wikipedia contributors, "Port forwarding," *Wikipedia, The Free Encyclopedia,* http://en.wikipedia.org/w/index.php?title=Port_forwarding&oldid=81828541 (accessed October 27, 2006).

[viii] Wikipedia contributors, "Private network," *Wikipedia, The Free Encyclopedia*, http://en.wikipedia.org/w/index.php?title=Private_network&oldid=83800681 (accessed October 27, 2006).
[ix] Wikipedia contributors, "IP address," *Wikipedia, The Free Encyclopedia*, http://en.wikipedia.org/w/index.php?title=IP_address&oldid=84616937 (accessed October 30, 2006).
[x] Wikipedia contributors, "Wide area network," *Wikipedia, The Free Encyclopedia*, http://en.wikipedia.org/w/index.php?title=Wide_area_network&oldid=81992909 (accessed October 27, 2006).
[xi] Wikipedia contributors, "WWAN," *Wikipedia, The Free Encyclopedia*, http://en.wikipedia.org/w/index.php?title=WWAN&oldid=71883297 (accessed October 27, 2006).

# Finding the IP Address

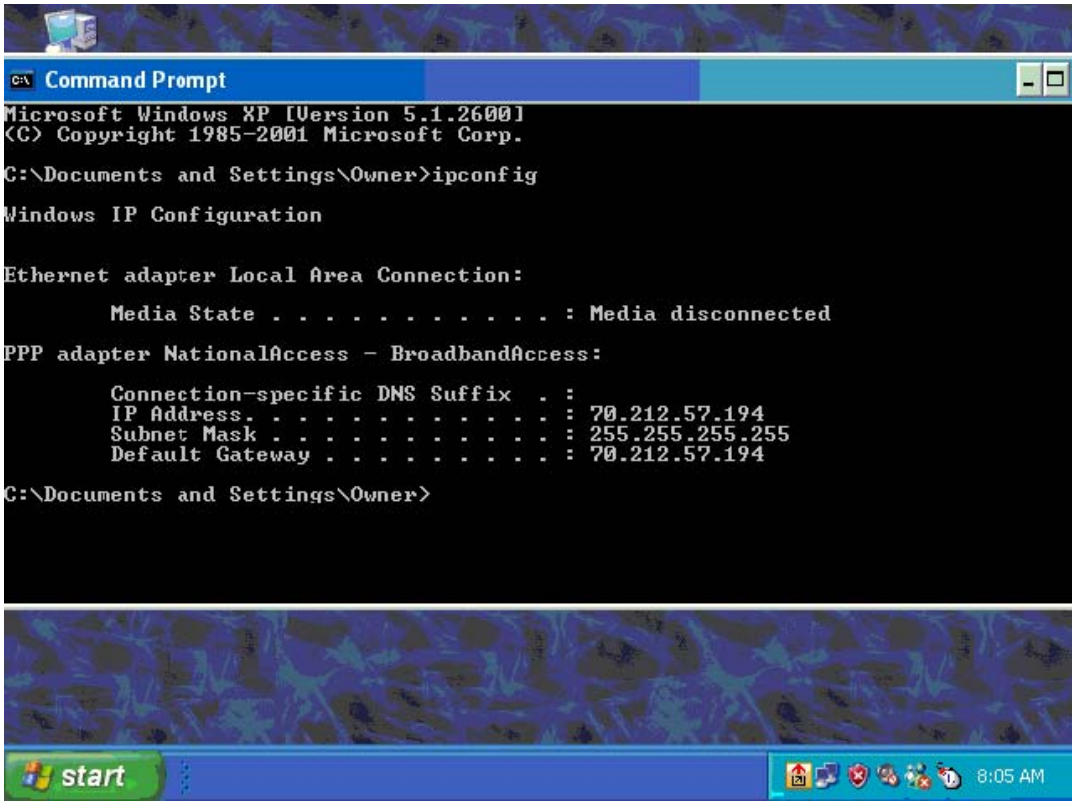
There are two possible scenarios:

1. The PAX is set-up as the Client and the computer running the PDA-W program is set-up as the Server.
2. The PAX is set-up as the Server and the computer running the PDA-W program is set-up as the Client.

**1. The PAX is set-up as the Client and the PDA-W program as the Server**

This is the most common configuration, due to the fact that the WAN IP address of the computer where the PDA-W program is installed usually does not change much, whereas the IP address of the PAX will likely change more often, especially if you are connecting through a cell phone. In this mode of operation you don't need to know the IP address of the PAX (which will probably change each time you make a connection); it is only necessary to input the PDA-W IP address on the PAX (running the PDA-R program). In order to obtain the IP address of the computer running the PDA-W program, there are two possibilities:

1. If the computer is directly connected to the Internet, through for instance a Cable or DSL modem, or through a cell phone, proceed as follows: Obtain a DOS prompt (Start, All Programs, Accessories, Command Prompt), then type 'ipconfig' without the quotes. The 'ipconfig' command produces output similar to that found in the picture below:



Look at the data following the 'PPP adapter NationalAccess – BroadbandAccess' title. Note the IP Address. This is your WAN or WWAN IP Address, that is, the number provided to you by your ISP. NOTE: If you cannot see the 'PPP adapter NationalAccess - BroadbandAccess' title, but only something similar to 'Ethernet adapter Local Area Connection', then most likely you are connected to the Internet through a LAN, and you should follow the instructions on item 2 below. Also have in mind that, unless you have made special arrangements with your ISP, your IP address will not be static. This means that there is no guarantee that it will be the same the next time you connect to the Internet - although there is a big chance that it will be. It is therefore recommended that you check your IP address every time a new connection is made.

2. If the computer is connected to the Internet through a LAN or a router, you will have to find the IP address of the Internet connection. This is not the same as your computer's IP address, which would be informed by the 'ipconfig' program explained on item 1. In order to find this number you can ask your network administrator, or use the web browser on the computer running the PDA-W program to access web sites like www.whatsmyip.org, which will inform the IP address of the device accessing the site. Note that in some cases the IP address informed by the web site is not exactly the same as the one required for accessing your computer on the Internet, so if you use this number and are not able to establish a connection you should contact your IT department or network administrator. Also, if the computer is connected to the Internet through a LAN or router you will need Port Forwarding, which should be set-up by your network administrator or by following the instructions in your router's manual.

Either one of the procedures above will allow you to find the number which will have to be input on the PDA-R program in order for it to able to find the specific PDA-W program on the Internet. Note that this number cannot be within the range of IP addresses reserved for private networks(see list on page 32). If the number that you have found is within this range, then it is not the correct one.

**2. The PAX is set-up as the Server and the PDA-W program as the client**

This configuration should be used only when the Internet connection on the computer running the PDA-W program is less reliable than the connection on the PAX. Whenever the connection on the computer running the PDA-W program is reestablished, it is possible that its IP address will change. If the PAX is set-up as the client, this will require that it is reconfigured with the new PDA-W address. On the other hand, if the PAX is set-up as the Server it does not need to know the IP address of the computer running the PDA-W program. In this case you will need the IP address of the PAX so that you can set-up the PDA-W program to look for the PAX on the Internet. In order to do that, proceed as follows:

1. Make sure that the PAX is connected to the Internet. Don't run the PDA-R program at this time.

2. Obtain a DOS prompt (Start, All Programs, Accessories, Command Prompt). Using the on-screen keyboard (Start, All Programs, Accessories, Accessibility, On-Screen Keyboard) or an external USB keyboard, type 'ipconfig' without the quotes. If you are using the on-screen keyboard, then make sure that the DOS command prompt window has the focus before you begin entering text, as the current focus window receives the text from the on-screen keyboard. The 'ipconfig' command produces output similar to that found on item 1.1 above.

Look at the data following the 'PPP adapter NationalAccess – BroadbandAccess' title. Note the IP Address. This is your WAN or WWAN IP Address, which will be used to setup the PDA-W program as a client. It will remain constant as long as the current Internet connection on the PAX is maintained, but should be rechecked whenever a new connection is made.

# Appendix G

## How to Use the On-Line Help Feature

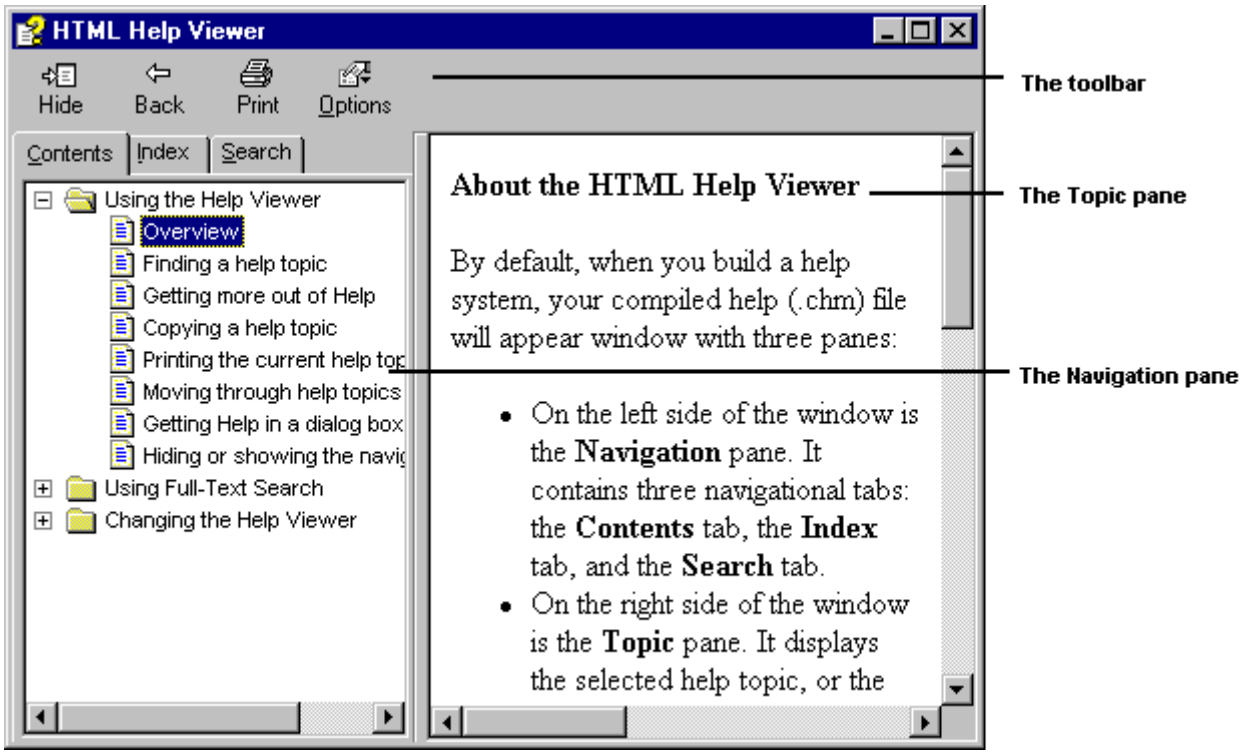
## About the Help Viewer

This Help Feature uses the Help Viewer which is an integral part of Microsoft Windows®. These related topics describe most of the general features available in the Help Viewer.

**Note :**
In order to take advantage of all the on-line help features you should open the *On-Screen Keyboard* by touching *Start*, then *Programs*, *Accessories*, *Accessibility* and choosing *On-Screen Keyboard*. It is also possible to connect a keyboard and a mouse to your PAX USB ports, or to run the on-line help on any computer running windows XP by copying the file with extension .chm from the "AppDir" folder on the PAX

### The HTML Help Viewer

This is a help file as it appears in the HTML Help Viewer.



## Using HTML Help Viewer

This Help feature appears in a window with three panes:

- On the left side of the window is the **Navigation** pane. It contains three navigational tabs: the **Contents** tab, the **Index** tab, and the **Search** tab.
- On the right side of the window is the **Topic** pane. It displays the selected help topic, or the default help topic.
- The third pane is the **toolbar**, which is located below the help window title bar.

## Getting more out of help

Here are some tips on how to find more information when using the HTML Help Viewer:

- To link to another topic, a Web page, a list of other topics, or a program, click the colored, underlined words.
- To view topics that contain related information, click the words, "Related Topics," which may appear at the end of a topic, and then click the title of the topic you want.
- If you use a particular help topic often, you may want to add it to your favorites list.
- Right-click the **Contents** tab or Topic pane for shortcut menu commands. (Note: You need to connect a mouse to one of the USB ports for that)

## To find a help topic

In the Navigation pane, click one of the following tabs:

- To browse through a table of contents, click the **Contents** tab. The table of contents is an expandable list of important topics.
- To locate every occurrence of a word or phrase that may be contained in a help file, click the **Search** tab, and then type the word. (This requires that a keyboard be connected to the PAX USB port.)

**Note**

- Click the contents or search results entry to display the corresponding topic.

### To find information with advanced full-text search

1. Click the **Search** tab, and then type the word or phrase you want to find.
2. Click ▸ to add Boolean operators to your search.
3. Click **List Topics**, select the topic you want, and then click **Display**.
4. To sort the topic list, click the **Title**, **Location**, or **Rank** column heading.

**Notes**

- You may precisely define a search by using wildcard expressions, nested expressions, and Boolean operators.
- You may request similar word matches, search only the topic titles, or search the results of a previous search.
- You may set the Help Viewer to highlight all instances of search terms that are found in topic files. Click the **Options** button, and then click **Search Highlight On**. This feature only works with Internet Explorer 4.0 or later.

### To use full-text search

1. Click the **Search** tab, and then type the word or phrase you want to find.
2. Click **List Topics**, select the topic you want, and then click **Display**.

### About advanced full-text search

Advanced full-text search allows a user to search using Boolean, wildcard, and nested expressions. A user may also limit the search to previous results, match similar words, or search topic titles only.

### To create a list of favorite help topics

1. Locate the help topic you want to make a favorite topic.
2. Click the **Favorites** tab, and then click **Add**.

**Notes**

- To return to a favorite topic, click the **Favorites** tab, select the topic, and then click **Display**.
- If you want to rename a topic, select the topic, and then type a new name in the **Current topic** box.

To remove a favorite topic, select the topic and then click **Remove**.

### To copy a help topic

Select the text you want to copy, right-click, and then click **Copy**.

### To print the current help topic

▸ Right-click a topic, and then click **Print**.

**Note**

- If you print from the **Contents** tab (by right-clicking an entry, and then clicking **Print**) you will see options to print only the current topic, or the current topic and all subtopics.

### To find topics using the toolbar buttons

There are five navigational buttons that may be located on the toolbar in the Help Viewer. You may click these buttons to find help topics:

- **Back** displays the last topic you viewed.
- **Forward** displays the next topic in a previously displayed sequence of topics.
- **Next** displays the next topic listed in the table of contents.
- **Previous** displays the previous topic listed in the table of contents.
- **Home** displays the Home page topic for the help file you are viewing.

### To highlight words in searched topics

When searching for words in help topics, you may have each occurrence of the word or phrase highlighted in the topics that are found.

▸ To highlight all instances of a search word or phrase, click **Options** on the toolbar, and then click **Search Highlight On**.

**Notes**

- To turn off this option, click **Options** on the toolbar, and then click **Search Highlight Off**.
- If you are viewing a long topic, only the first 500 instances of a search word or phrase will be highlighted.

### To hide or show the Navigation pane

▸ On the toolbar, click **Hide** or **Show** to close or display the Navigation pane, which contains the **Contents**, **Index**, **Search**, and **Favorites** tabs.

**Note**

- If you close the Help Viewer with the Navigation pane hidden, it will appear that way when you open the Help Viewer again.

## Using Accessibility Shortcut Keys in the Help Viewer

The following keyboard shortcuts may be used for navigation in the HTML Help Viewer.

For the Help Viewer:

| To | Press |
|---|---|
| Close the Help Viewer. | ALT+F4 |
| Switch between the Help Viewer and other open windows. | ALT+TAB |
| Display the Options menu. | ALT+O |
| Change Microsoft Internet Explorer settings. The **Internet Options** dialog box contains accessibility settings. To change these settings click the **General** tab, and then click **Accessibility**. | ALT+O, and then press I |
| Hide or show the Navigation pane. | ALT+O, and then press T |
| Print a topic. | ALT+O, and then press P, or right-click in the |
| Move back to the previous topic. | ALT+LEFT ARROW, or ALT+O, and then press B |
| Move forward to the next topic (provided you have viewed it just previously). | ALT+RIGHT ARROW, or ALT+O, and then press F |
| Turn on or off search highlighting. | ALT+O, and then press O |
| Refresh the topic that appears in the Topic pane (this is useful if you have linked to a Web page). | F5, or ALT+O, and then press R |
| Return to the home page. | ALT+O, and then press H |
| Stop the viewer from opening a page (this is also useful if you are linking to the Web and want to stop a page from downloading). | ALT+O, and then press S |
| Switch between the Navigation pane and the Topic pane. | F6 |
| Scroll through a topic. | UP ARROW and DOWN ARROW, or PAGE UP and PAGE DOWN |
| Scroll through all the links in a topic or through all the options on a Navigation pane tab. | TAB |

For the **Contents** tab:

| To | Press |
|---|---|
| Display the **Contents** tab. | ALT+C |
| Open and close a book or folder. | PLUS SIGN and MINUS SIGN, or LEFT ARROW and RIGHT ARROW |
| Select a topic. | DOWN ARROW and UP ARROW |

| | |
|---|---|
| Display the selected topic. | ENTER |

For the **Index** tab:

| **To** | **Press** |
|---|---|
| Display the **Index** tab. | ALT+N |
| Type a keyword to search for. | ALT+W, and then type the word |
| Select a keyword in the list. | UP ARROW and DOWN ARROW |
| Display the associated topic. | ALT+D |

For the **Search** tab:

| **To** | **Press** |
|---|---|
| Display the **Search** tab. | ALT+S |
| Type a keyword to search for. | ALT+W, and then type the word |
| Start a search. | ALT+L |
| Select a topic in the results list. | ALT+T, and then UP ARROW and DOWN ARROW |
| Display the selected topic. | ALT+D |
| **The following options are only available if full-text search is enabled.** | |
| Search for a keyword in the result list of a prior search. | ALT+U |
| Search for words similar to the keyword. For example, to find words like "running" and "runs" for the keyword "run." | ALT+M |
| Only search through topic titles. | ALT+R |

For the **Favorites** tab:

| To | Press |
|---|---|
| Display the **Favorites** tab. | ALT+I |
| Add the currently displayed topic to the Favorites list. | ALT+A |
| Select a topic in the Favorites list. | ALT+P, and then UP ARROW and DOWN ARROW |
| Display the selected topic. | ALT+D |
| Remove the selected topic from the list. | ALT+R |

**Notes**

- There are also shortcut menu commands that may be accessed through the keyboard.
- Shortcut keys also work in secondary and pop-up windows.
- Every time you use a shortcut key in the Navigation pane, you lose focus in the Topic pane. To return to the Topic pane, press F6.
- The **Match similar words** check box, on the **Search** tab, will be selected if you used it for your last search.

## Using the shortcut menu commands

There are several commands on the shortcut menu that you may use to display and customize information.

| Command | Description |
|---|---|
| Right-click in the table of contents, and then click **Open All**. | Opens all books or folders in the table of contents. This command only works if the **Contents** tab is displayed. |
| Right-click in the table of contents, and then click **Close All**. | Closes all books or folders. This command only works if the **Contents** tab is displayed. |
| Right-click, and then click **Print**. | Prints the topic. |

**Note**

- These commands may be accessed through the keyboard. You may click SHIFT+F10 to display the shortcut menu, and then click the appropriate shortcut keys. Or, you may enable Mousekeys. Use a Mousekey combination to display the shortcut menu, and then click the appropriate shortcut keys.

**To turn on MouseKeys**

1. To open the **Accessibility Properties** dialog box.
2. Click the **Mouse** tab.
3. Select the **Use MouseKeys** check box.

**Note**

- You may also open the **Accessibility Properties** dialog box by clicking **Start**, pointing to **Settings**, clicking **Control Panel**, and then double-clicking **Accessibility Options**.

**About the Search tab**

This help file includes a **Search** tab that allows a user to search through every word in a help file to find a match. For example, if a user does a full-text search on the word "index," every topic that contains the word "index" will be listed. NOTE: In order to use the search feature with your PAX it is necessary to open the *On-Screen Keyboard*, by touching *Start*, then *Programs*, *Accessories*, *Accessibility* and choosing *On-Screen Keyboard*. It is also possible to connect a keyboard to one of the USB ports.

Advanced full-text search allows a user to search using Boolean, wildcard, and nested expressions.

**Searching for help topics**

A basic search consists of the word or phrase you want to find. You may use wildcard expressions, nested expressions, Boolean operators, similar word matches, a previous results list, or topic titles to further define your search.

The basic rules for formulating queries are as follows:

- Searches are not case-sensitive, so you may type your search in uppercase or lowercase characters.
- You may search for any combination of letters (a-z) and numbers (0-9).
- Punctuation marks such as the period, colon, semicolon, comma, and hyphen are ignored during a search.
- Group the elements of your search using double quotes or parentheses to set apart each element. You cannot search for quotation marks.

**Note**

- If you are searching for a file name with an extension, you should group the entire string in double quotes, ("filename.ext"). Otherwise, the period will break the file name into two separate terms. The default operation between terms is AND, so you will create the logical equivalent to "filename AND ext."

**Searching for words or phrases**

You may search for words or phrases and use wildcard expressions. Wildcard expressions allow you to search for one or more characters using a question mark or asterisk. The table below describes the results of these different kinds of searches.

| Search for | Example | Results |
|---|---|---|
| A single word | select | Topics that contain the word "select." (You will also find its grammatical variations, such as "selector" and "selection.") |
| A phrase | "new operator"<br>or<br>new operator | Topics that contain the literal phrase "new operator" and all its grammatical variations.<br><br>Without the quotation marks, the query is equivalent to specifying "new AND operator," which will find topics containing both of the individual words, instead of the phrase. |
| Wildcard expressions | esc*<br>or<br>80?86 | Topics that contain the terms "ESC," "escape," "escalation," and so on. The asterisk cannot be the only character in the term.<br><br>Topics that contain the terms "80186," "80286," "80386," and so on. The question mark cannot be the only character in the term. |

**Note**

- Select the Match similar words check box to include minor grammatical variations for the phrase you search.

**Defining search terms**

The AND, OR, NOT, and NEAR operators enable you to precisely define your search by creating a relationship between search terms. The following table shows how you may use each of these operators. If no operator is specified, AND is used. For example, the query "spacing border printing" is equivalent to "spacing AND border AND printing."

| Search for | Example | Results |
|---|---|---|
| Both terms in the same topic. | dib AND palette | Topics containing both the words "dib" and "palette." |
| Either term in a topic. | raster OR vector | Topics containing either the word "raster" or the word "vector" or both. |
| The first term without the second term. | ole NOT dde | Topics containing the word "OLE," but not the word "DDE." |

| | | |
|---|---|---|
| Both terms in the same topic, close together. | user NEAR kernel | Topics containing the word "user" within eight words of the word "kernel." |

**Using nested expressions when searching**

Nested expressions allow you to create complex searches for information. For example, "control AND ((active OR dde) NEAR window)" finds topics containing the word "control" along with the words "active" and "window" close together, or containing "control" along with the words "dde" and "window" close together.

The basic rules for searching help topics using nested expressions are as follows:

- You may use parentheses to nest expressions within a query. The expressions in parentheses are evaluated before the rest of the query.
- If a query does not contain a nested expression, it is evaluated from left to right. For example: "Control NOT active OR dde" finds topics containing the word "control" without the word "active," or topics containing the word "dde." On the other hand, "control NOT (active OR dde)" finds topics containing the word "control" without either of the words "active" or "dde."
- You cannot nest expressions more than five levels deep.

**To search for words in the titles of HTML files**

1. Click the **Search** tab, type the word or phrase you want to find, and then select the **Search titles only** check box.
2. Click **List Topics**, select the topic you want, and then click **Display**.

**Note**

- The titles of the HTML files are not necessarily identical to those appearing at the top of the corresponding texts.
- If you use this option, all HTML topic files will be searched, including any that are not listed in the table of contents.

**To find words similar to your search term**

This feature enables you to include minor grammatical variations for the phrase you search. For example, a search on the word "add" will find "add," "adds," and "added."

1. Click the **Search** tab, type the word or phrase you want to find, and then select the **Match similar words** check box.
2. Click **List Topics**, select the topic you want, and then click **Display**.

**Note**

- This feature only locates variations of the word with common suffixes. For example, a search on the word "add" will find "added," but it will not find "additive."

**To search only the last group of topics you searched**

This feature enables you to narrow a search that results in too many topics found. You may search through your results list from previous search by using this option.

1. On the **Search** tab, select the **Search previous results** check box.
2. Click **List Topics**, select the topic you want, and then click **Display**.

**Notes**

- If you want to search through all of the files in a help system, this check box must be cleared.
- The **Search** tab will open with this check box selected if you previously used this feature.

**To customize the Help Viewer**

There are a few ways to easily change the size and position of the Help Viewer and the panes in the viewer:

- To resize the Navigation or Topic pane, point to the divider between the two panes. When the pointer changes to a double-headed arrow, drag the divider right or left.
- To proportionately shrink or enlarge the whole Help Viewer, point to any corner of the Help Viewer. When the pointer changes to a double-headed arrow, drag the corner.
- To change the height or width of the Help Viewer, point to the top, bottom, left, or right edge of the Help Viewer. When the pointer changes to a double-headed arrow, drag the edge.
- To reposition the Help Viewer on your screen, click the title bar and drag the Viewer to a new position.

**Note**

- The Help Viewer will appear with the last size and position settings you specified when it is opened again.

**To change formatting or styles for accessibility**

1. On the **Options** menu, click **Internet Options**, and then click **Accessibility**.
2. In the **Accessibility** dialog box, select the options you want, and then click **OK**.

**Notes**

- These changes do not apply to the Navigation pane or toolbar of the Help Viewer.
- This will also change your accessibility settings for Internet Explorer 4.0 or later.

**To change the font size of a topic**

▸ Click on the  button **or**

▸ On the **Options** menu, click **Internet Options**, and then click **Fonts**. This will also change your font settings for Internet Explorer.

**Note**

- These changes do not apply to the Navigation pane or toolbar of the Help Viewer.

**To change colors in the Topic pane of the Help Viewer**

1. In Microsoft Internet Explorer 4.0, on the **View** menu, click **Internet Options**.
2. On the **General** tab, click **Colors**.
3. In the **Colors** dialog box, select the options you want, and then click **OK**.
4. To apply the new color settings, in the **Internet Options** dialog box, click **OK**.

**Notes**

- These changes do not apply to the Navigation pane or toolbar of the Help Viewer.
- This will also change your color settings for Internet Explorer 4.0 or later.