USER GUIDE

PRECISION ACOUSTICS

Ultrasound Test Tank Systems

UMS Control Software: User guide

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INTRODUCTION

UMS is a custom built test tank system for making a variety of ultrasound measurements. This manual describes the use of the system and supplied software for making measurements and post-processing acquired data to obtain relevant acoustic parameters.

Throughout this manual, whenever a front panel control is referred to it will be identified thus:

<Finish> a control or indicator labelled “Finish” on the front panel

<File→Open> the “Open” item from within the “File” menu on the front panel

Items relevant to the safe operation of the UMS system will be highlighted as per this entry.

SETTING UP THE SYSTEM

Installation of the UMS software

The UMS control centre software is pre-installed on the host PC supplied with the test tank system. Should you need to reinstall the software at any point in the future, an installation disk is supplied with the system. For installation instructions, please see the “readme” file on the installation disk.

Connecting external devices

The UMS control centre software is designed to operate the UMS test tank system, incorporating a digital storage oscilloscope (DSO). The system can also be used to control several models of HP/Agilent function generators, a thermocouple and an optional 2 rotational axis transducer mount. Prior to running the software, ensure that the UMS system and any peripherals are connected to the host PC and powered up as described in the UMS system manual.

Emergency stop switch (E-Stop)

The UMS comes complete with a hardware emergency stop switch. This latching push button switch, when activated, cuts power to all of the system stepper motors and causes the system to halt motion immediately.

The consequences of pressing the ESTOP are as follows:

1. Power is immediately cut to the stepper motors on the linear axes and if applicable the stepper motor controlled rotary table.
    a. Logic power supply to the stepper controllers and encoders is maintained allowing the system to maintain a record of its position.
2. All power is cut to the optional Gimbal mount (assuming the gimbal mount wiring is integral to the system, where a gimbal mount has been supplied as an add-on, this may not apply).

   a. Note: Since the motors used in the current gimbal mount are servos, they can be "backdriven" when power is removed. Therefore, great care should be taken to avoid mounting heavy items on the gimbal above its pivot point (as this arrangement is inherently unstable and removing power could cause the load to flip and potentially cause damage to the system).

3. The software process which was running will detect the ESTOP activation and "pause" its execution. A dialogue is displayed on the screen indicating that the ESTOP has been activated. The user can then clear this dialogue by selecting the appropriate option once the ESTOP has been released.

The software warning dialogue is displayed on the software when the E-Stop has been activated. The dialogue gives the user 3 options, for resuming operation after the E-stop has been activated:

1. **<Skip>**: Discard the operation (move) which was interrupted by the E-Stop and move to the next move operation.
2. **<Retry>**: Attempt to complete the requested move which was interrupted by the E-Stop.
3. **<Abort>**: Discard the interrupted movement and abort any running scans/scripts.

(Note, 1. and 3. are equivalent if only a single move was commanded and interrupted).

The system will not move and may not properly initialise if the E-Stop switch is latched, ensure the switch is released once the situation leading to its use has passed and when starting the UMS software.

Prior to using the system, ensure that the whereabouts of the E-Stop switch is known and that the switch is within easy reach of the user.

Axis limit switches

In addition to the E-Stop switch, each linear axis has two mechanical limit switches. Prior to use, these should be positioned such as to protect both the tank (i.e. to prevent the moving parts of the XYZ stage colliding with the water tank walls) and any other user devices (hydrophones, transducers etc) within the tank.

As with the E-Stop switch, if any of the limit switches is activated during movement, that movement will halt immediately and a dialogue message will be displayed in the user interface indicating which limit switch was activated and offering the user the same three options as for the E-Stop control. For more information on the operation of the limit switches, see the UMS system manual.

THE UMS USER INTERFACE

Introduction

The UMS user interface software provides complete control of the UMS scanning test tank system. The software permits a wide range of data acquisition tasks for ultrasonic measurement. Data acquired by the UMS software can be subsequently loaded into the post processing application for analysis. A flow chart overview of the UMS software can be seen in Figure 1. In addition to the individual measurement tasks highlighted in the figure, UMS also allows users to define and execute a series of automated tasks to perform through scripting, offering significant time saving.

When UMS is loaded, the software checks for, and initialises, the various hardware elements of the test tank system (as configured through a preferences file). Once initialisation is complete, the front "welcome" page is displayed as shown in Figure 2. The user interface is divided into 4 active regions. The top row and right hand side remain static during operation, providing access to the various possible actions and status, position and configuration information. The central main display area is dynamically updated with controls and indicators specific to the selected measurement task (action). The numbered items from Figure 2 are described below.

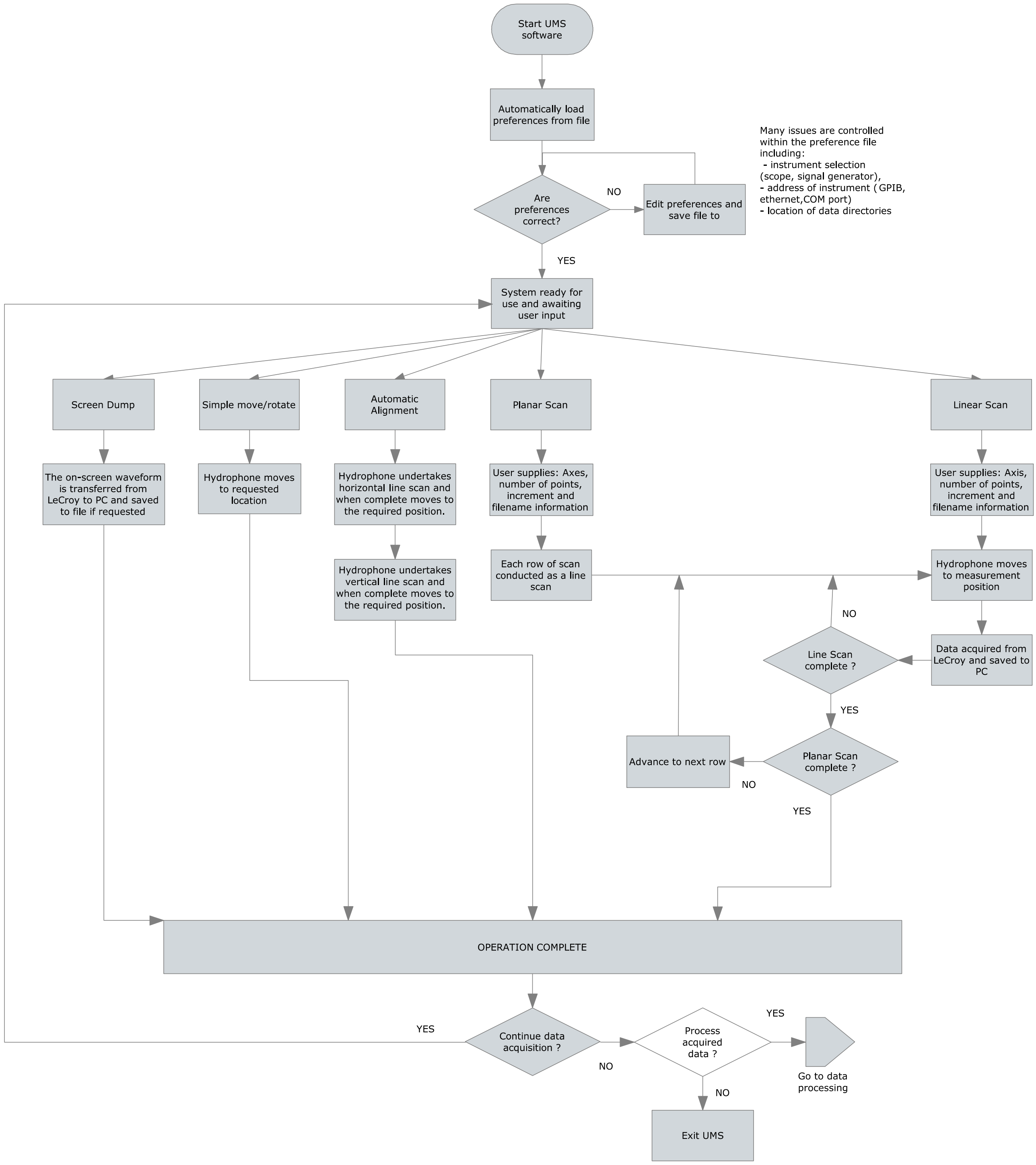


Figure 1. Flow chart overview of UMS software

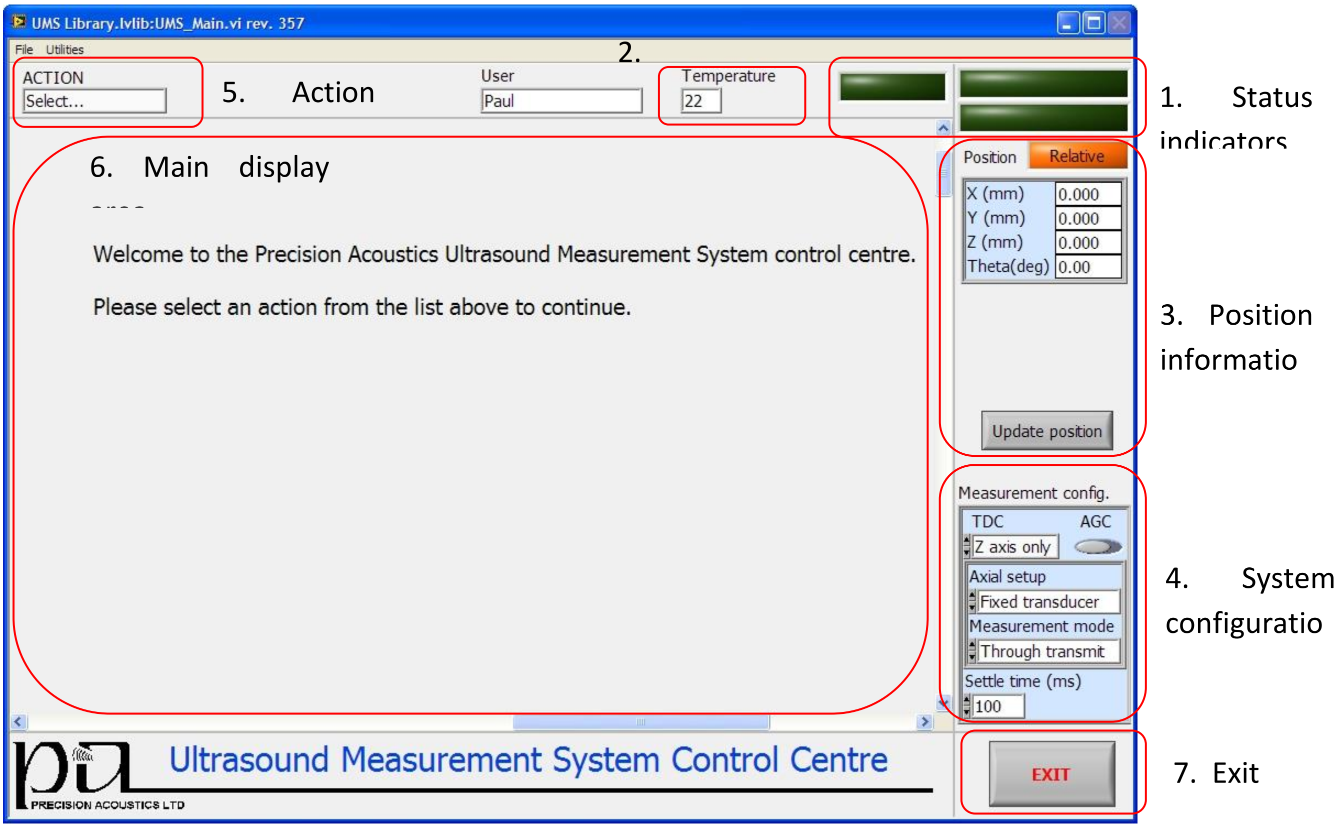


Figure 2. Opening page of UMS software interface

1. Status indicators:

The status LEDs indicate when the system is either moving or processing a command. The third, smaller LED indicates whether the "z" axis of the system is vertical. When neither LED is lit, the system is idle.

2. Temperature:

The **<Temperature>** control/indicator is used to display the current water temperature. If UMS has been configured to work with a temperature measurement device (e.g. thermocouple), then the current measured temperature is displayed. If no thermocouple is available, the control defaults to 22 °C. If the water temperature is known to the user, i.e. through some external thermometer, it can be manually entered into the control. Subsequent temperature dependant calculations will then use the entered value.

3. Position information

The **<Position>** control displays the current position of the moving axes, along with an indicator showing whether the system is operating in relative co-ordinate mode (i.e. positions given relative to startup position) or absolute mode (i.e. positions given relative to an absolute reference within the tank). More about the available co-ordinate systems is given in the section "Definition of Axes". **<Update position>** allows the user to update the displayed position if the axes have been moved manually.

4. System configuration

The **<Measurement config>** control/indicator shows the current settings of the system. From this control, the user can select Time Delay Compensation (TDC) mode, enable Automatic Gain Control (AGC), set the axial setup (fixed transducer or scanning transducer) and measurement modes (pulse-echo or through transmit) and set the settle time used after each move to minimize the effect of vibration on measurements.

5. Action list

The **<ACTION>** list is used to select the task to perform.

6. Main display area

The main display area is dynamically updated to show the relevant controls/indicators for the selected action.

7. Exit

The **<EXIT>** control closes down communication with the UMS system and other peripherals (oscilloscope, function generator) etc and exits the program.

Measurement Configuration

Time Delay Compensation (TDC)

The time delay compensation (TDC) function within UMS is designed to allow users to perform automated measurements which change the time of flight of the acoustic wave between the source and detector, and which would otherwise require user intervention to maintain the acoustic signal within the acquisition window of the oscilloscope. The purpose of TDC is to automatically adjust the time delay setting on the oscilloscope such that the signal of interest is maintained within the acquisition window even if the time of flight changes due to a movement.
Two modes of TDC are available: Z axis only and XYZ. The former offers the simplest implementation of TDC. In this mode, only moves parallel to the acoustic axis cause a change in the time delay. For each move in Z, the distance moved is converted to a change in time delay (using the water temperature dependent speed of sound) which is then sent to the oscilloscope. In XYZ TDC mode, the distance between the source and detector is calculated and used to update the oscilloscopes time delay. When XYZ TDC is selected the user is prompted to perform a **<Find beam max>** operation in order that the system can determine the co-ordinates of the front face of the source. This is necessary for the proper operation of XYZ TDC. Once complete, the system uses simple trigonometry to determine the source-detector separation after each move and update the time delay accordingly. For most applications, it is likely that "Z axis" TDC will be sufficient.

For proper operation of both TDC modes it is necessary that **<Axial setup>** and **<Measurement mode>** controls are appropriately set. Additionally, an accurate water temperature is required for optimum TDC operation.

Automatic Gain Control (AGC)

The automatic gain control (AGC) is designed to set the oscilloscope gain and offset to optimise signal acquisition. When enabled, prior to any data acquisition, a single snapshot waveform is acquired from the oscilloscope and the maximum and minimum voltage values are compared to the current range and offset of the scope display. A simple algorithm then adjusts the gain and offset settings to centre the signal in the display and fill approximately 80% of the vertical space. Once complete, the requested acquisition task is completed.

AGC is most useful when performing scans on focussed fields where the variation in signal amplitude over the scan range is large.

Care must be taken to ensure that the maximum voltage output from the detector is less than the maximum safe voltage of the 50 Ohm input to the oscilloscope, otherwise damage may occur.

When performing scans on fields where it is known that the signal variation is minimal, it may be more time efficient to disable AGC as it will have a detrimental effect on scan times.

Axial Setup

The **<Axial setup>** control (within **<Measurement config.>**) must be set to reflect whether the acoustic source (Transducer) is fixed in position or mounted on the moving XYZ axes.

Correct setting of this value is required for TDC **<Move to dt>** to function correctly.

Measurement Mode

The **<Measurement mode>** control must be set to reflect whether the system is being used for pulse-echo (i.e. transducer-reflector) measurements or "through transmit" (i.e. transducer-hydrophone) measurements.

The correct setting of this control is required for TDC and **<Move to dt>** to function correctly.

Settle time

The **<Settle time>** control allows the user to set a time delay to be observed after each move command. This allows any vibration or oscillation in the scanning axes to stabilise prior to data acquisition. The amount of settle time required depends on many factors including the mass and size of devices mounted on the axes, the stability of the floor on which the system is mounted etc. It is thus up to the user to set an appropriate delay time for their system.

Setting measurement information

<ACTION→Set measurement info> allows the user to input system setup and measurement information relevant to the measurement task being undertaken. The measurement information page (Figure 3) contains a tab control allowing the user to enter information relating to the **<Device under test>**, the **<Measurement conditions>** and the **<Test equipment>** used for the set of measurements. The information entered is stored in the header of any data acquired and saved by the UMS software.

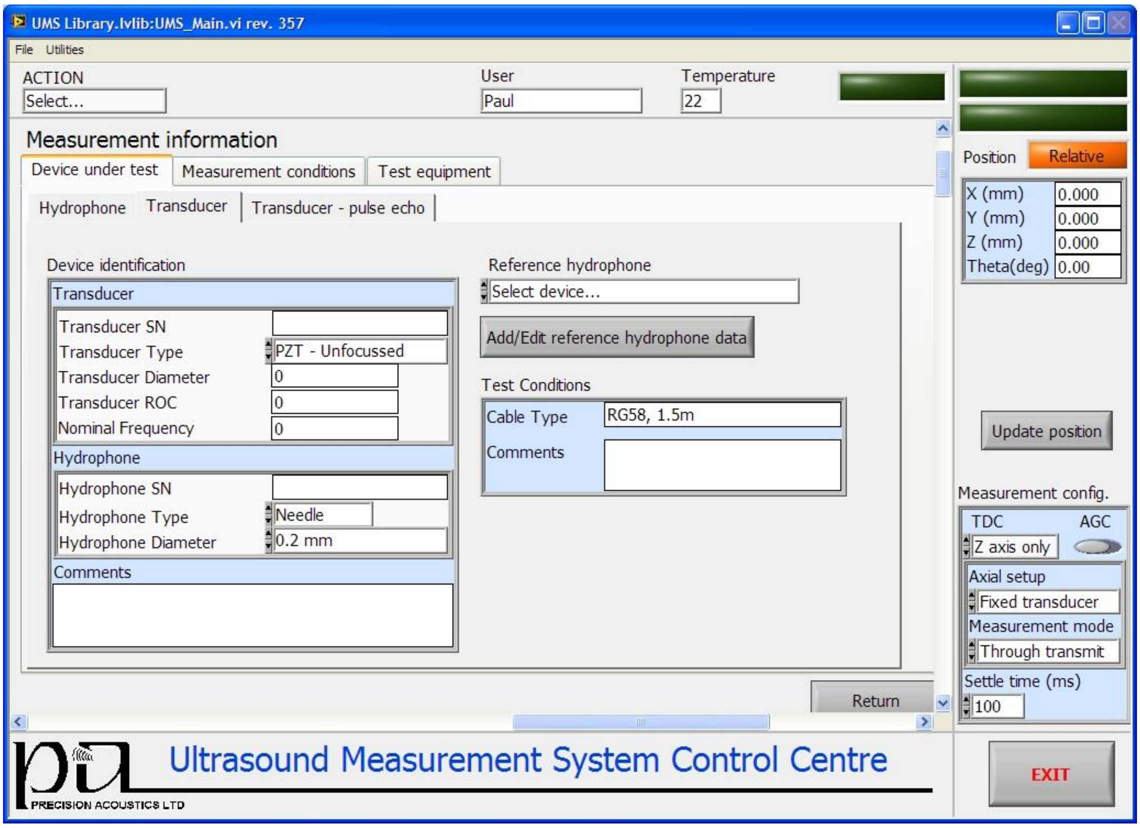


Figure 3. Set measurement information page

Configuring a function generator

To configure a function generator select **<ACTION→Configure source>.** This action allows the user to configure a supported function generator connected to the UMS host PC (e.g. via GPIB). The configure source page is shown in Figure 4. Any change to **<Function generator settings>** results in the immediate update of the generator output.

In addition to changing the current settings of the function generator, UMS allows the user to create, store and recall function generator configurations. The available "presets" are listed in the table on the lower half of the display. The buttons to the right allow the user to create, load or delete configurations.

Care should be taken regarding the order of configuration of a function generator since each change to **<Function generator settings>** takes immediate effect.

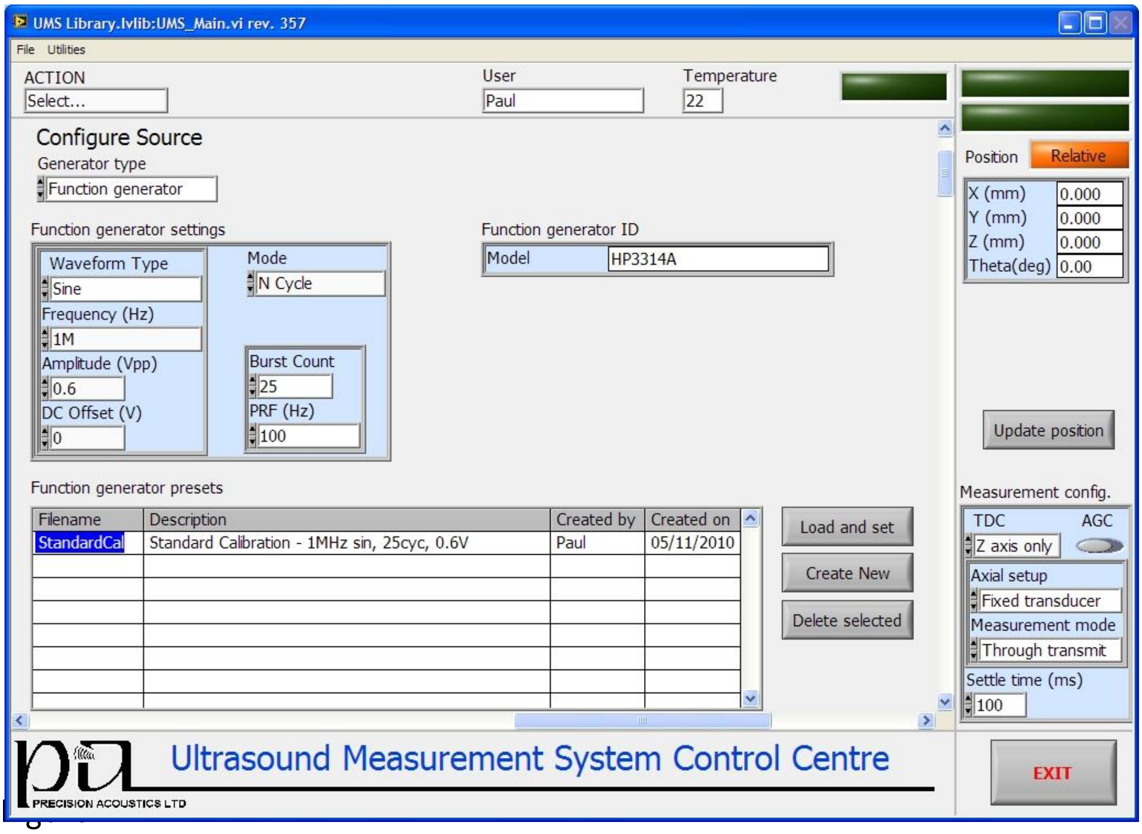


Figure 4. Configure source display

Moving the system

The UMS software allows the user to position the hydrophone/transducer manually within the test tank, as well as to perform automated alignment procedures. The "Move" page is shown in Figure 5. The display is split into 3 main sections – Single axis incremental movement, multi-axis positional movement and automated tasks. Incremental moves are achieved by selecting the desired **<Linear increment>** or **<Angular increment>**, and then clicking the **<+{Axis}>** or **<-Axis>** button for the axis to be moved. The system can also be moved to a specific co-ordinate in the current system by entering the value into the appropriate "go to" box and clicking **<Go to {Axis}>**. It is possible to set reference positions to return to at a later time (during the active session). 3 linear reference positions are available, they are set by positioning the system in the desired location (either manually or by means of an auto-alignment) and then pressing **<Set>** in the position box. To return to this position later simply press **<Go to>** in the **<Position {n}>** box.

When using the reference positions the system will move all axes simultaneously to reach the desired location, ensure that there is a clear path to the position before using this feature.

Of particular importance are the buttons on the left hand side (+X, -X etc)

If you click one of these buttons you will move the distance (shown in the Linear Increment box), in the direction indicated by that button. So, as shown in the image, clicking the +Z button will move you 1mm in the positive Z direction (i.e. away from the Z-axis motor). The linear increment box is a drop down selector and you can select a range of different increments from tenths of mm to hundreds of mm. Precision Acoustics ALWAYS recommends making a safety move first: move 1mm in the direction your intend to go (this is large enough to see visually but small enough that its unlikely to cause a crash). Once you have confirmed that your are moving the correct axis in the correct direction, change to a larger increment and move. If you wish to move 300mm in the –Y direction then change the increment to 100mm, and press the –Y button 3 times.

NB the system will Queue up moves so if click it 5 times by accident it will move 500 mm!!!

These type of moves are called incremental moves and are by far the safest way of moving the system.

The other type of move is called an absolute (or **goto**) move. If you type a number, for example 5 into the white box Z box and then press the **<Go to>** button on that line it will move to that position on the axis. This does not mean, "move an increment of", it means "move to" therefore it will move to position 5mm on the Z Axis. HOWEVER BEFORE pressing **<Go to>**, note carefully, from the position indicator on the top right hand corner which shows the current position, If this show Z as 200mm clicking the **<Go to>** on the Z axis with 5mm will give a new position of 205mm on the Z direction!! This is why **<Go to>** moves require greater care since you need to account for your current position and where that is relative to move position you are commanding.

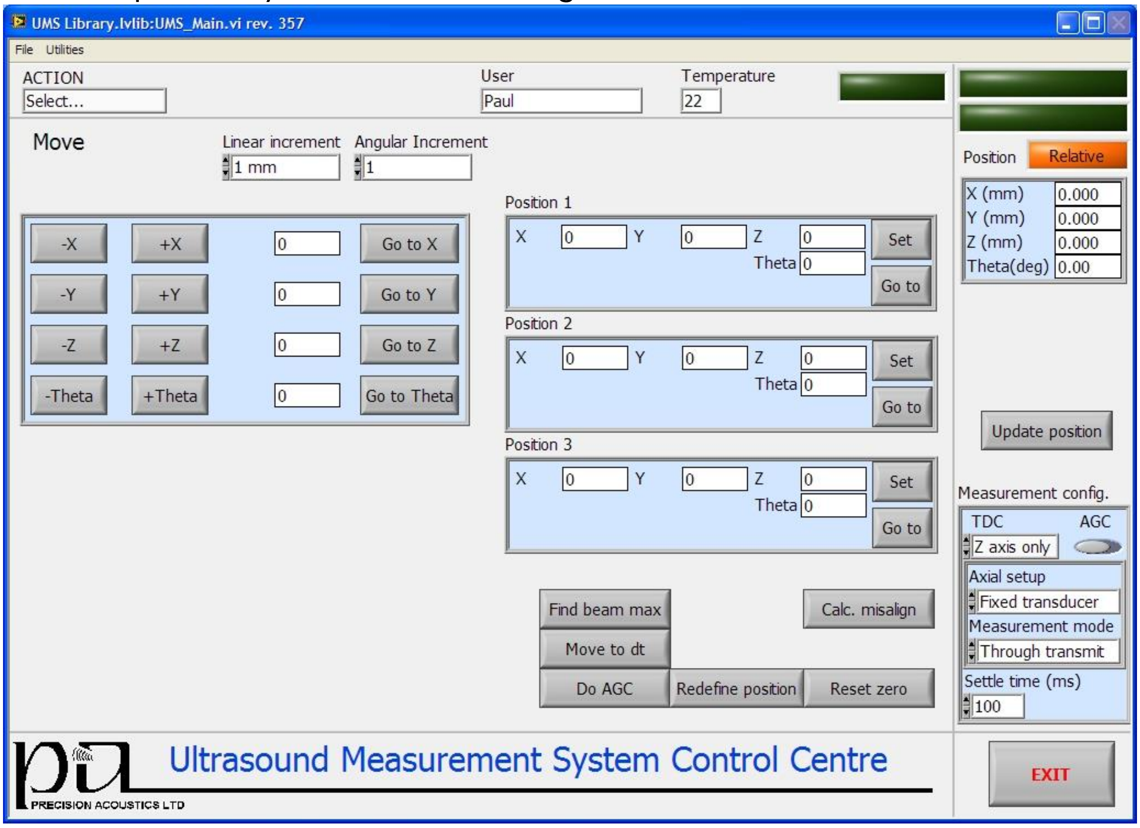


Figure 5. "Move" display

Definition of Axes

UMS offers two possible tank configurations – horizontal acoustic beam (along the tank) or vertical acoustic beam. The linear axis corresponding to the acoustic beam is always the "Z" axis. Additionally, the "X" axis is always the axis which crosses the test tank. When configured as a vertical system then, the "Y" axis is that which runs along the length of the test tank ("Z" being vertical). When configured as a horizontal system, the Z and Y axes are swapped, giving Z as the axis running along the length of the tank and Y as the vertical axis. Axis configuration can be set in the **<ACTION> → Set Preferences → <Hardware configuration> → <Stepper system>** control.

Autoalignment: Find beam max.

<Find beam max.> initiates an auto alignment algorithm designed to place the hydrophone/transducer at the position of maximum acoustic signal (max voltage squared integral- VSI) at the current distance from the transducer. The alignment is configured via the "Auto alignment algorithm settings" pop-up dialogue box (Figure 6). When started, the system will either perform a number of linear scans in the selected pair of (orthogonal) **<axes>**. The user selects the **<#points>** and **<Increment>** for the 1D scans and can then select from 3 **<alignment methods>**: Peak, Centre of -3/-6 dB drop and Centre of mass -3/-6 dB. For improved accuracy, the user can also use the **<Iterations>** control to set the order and number of times the autoalignment algorithm is run. Setting **<Iterations>** to 1 will run each selected axis once, setting it to 1.5 will run the algorithm on axis 1, axis 2 and then axis 1 again. The process always begins from the current position of the hydrophone/transducer.

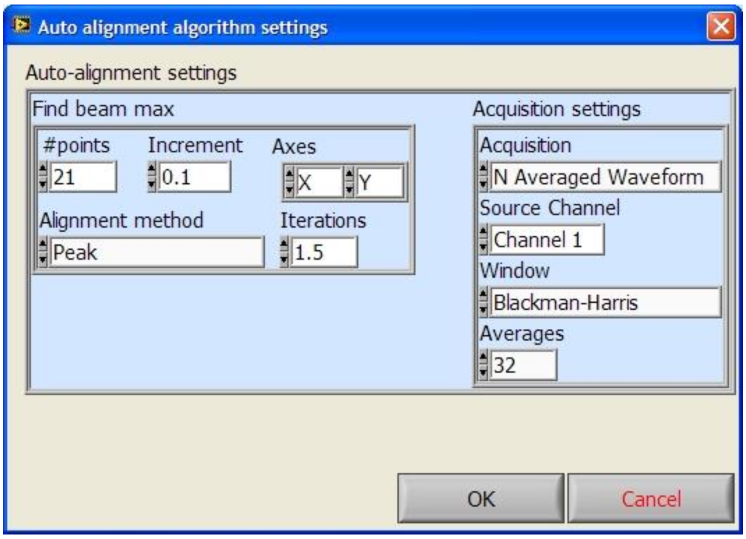


Figure 6. Auto alignment settings dialogue for find beam max.

<u>Peak:</u>

In this mode, the system will return the hydrophone/transducer to the position of maximum VSI after each line scan.

Centre of -3/-6dB drop:

In this mode, the system will find the positions of the -3 or -6 dB drops from the maximum and then move to the centre of these.

Centre of mass -3/-6dB:

In this mode, the system will compute the position of the centre of mass of the VSI profile between the positions of the -3 or -6dB drops and move to that position. The centre of mass is defined as the position corresponding to the average value of the integral of the VSI over the range selected and is calculated as:

$$x_{CoM} = \frac{\sum x_i VSI_i}{\sum VSI_i}$$

Calculate angular misalignment

The **<Calc. Misalign>** allows the user to measure the misalignment between the acoustic axis of a transducer and the Z axis of UMS. When selected, the "Auto alignment algorithm settings" dialogue (Figure 7) is launched to configure the measurement. To calculate the angular misalignment, UMS performs the "Find beam max" procedure at two distances from the transducer. The find beam max settings are configured as above, the user then specifies the **<Axial separation>** (the distance in mm between the two "Find beam max" procedures). The angular misalignment in the Abt_Y rotational axis is determined from the equation:

$$\Delta\theta_{Abt\_Y} = \tan^{-1}\left(\frac{x_2 - x_1}{z_2 - z_1}\right)$$

Hence it can be seen that for a fixed increment in the find beam max procedure, the larger the axial separation the better the resolution of the measurement. However, the system must find a maximum at each of the axial positions, so care must be taken to set up the measurement appropriately for any given transducer.

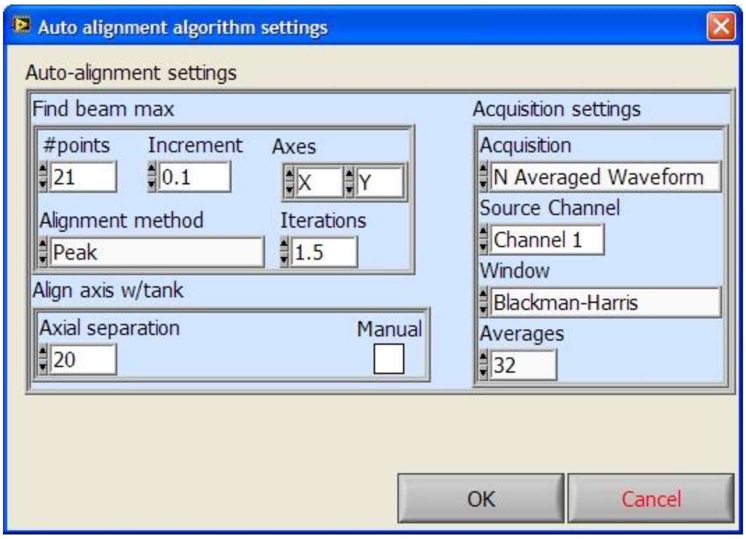


Figure 7. Auto alignment algorithm settings for calculation of misalignment

The user may run the calculation in **<Manual>** mode. In this instance, the system will pause after the first find beam maximum before proceeding to the 2nd axial position. At the end of the measurement, the acquired profiles are displayed along with the calculated angular misalignment of the system.

Align Axis w/Tank

The **<Align axis w/tank>** option is only available if the system was supplied with a 2 axis gimbal mount allowing rotation in the Abt_X and Abt_Y senses. This function aligns the acoustic axis of a transducer held in the gimbal mount with the Z axis of the scanning system by adjusting the Abt_X and Abt_Y axes. The automated sequence performs a "Calculate misalignment" procedure as detailed above, the misalignment is then corrected by adjusting the gimbal mount, the measurement is then repeated to verify the movement. The user can select the **<Find beam max>** options to use as well as specify an angular **<Tolerance>** for misalignment (when the calculated misalignment is less than the tolerance, the system is considered to be aligned and the process ends). In addition to the settings for the measurement of the angular misalignment the user can enable "Translation compensation" **<Trans. Comp.>** to compensate for any translational motion of the transducer caused by movement of the gimbal during the alignment (This is designed to reduce the possibility of the system losing the acoustic signal following the corrective gimbal movements). When this is enabled, the user must specify both the vertical distance between the rotational axes of the gimbal and the front surface of the transducer and any time delay between the scope triggering pulse and the generation of the acoustic signal (note, this is NOT the same as the time delay seen on the oscilloscope, this is the delay between generation of the trigger pulse and the acoustic signal). If these values cannot be specified, the translation compensation will not work and the user should take care when setting up an alignment to ensure the scans are wide enough that the signal is not lost.

The settings used for an alignment can be saved to and loaded from disk using the **<Save>** and **<Load>** buttons in the dialogue.

When using the Align axis with tank procedure with the PA gimbal, several things must be taken into account. The positional resolution and precision of the gimbal mount at 1° and +/- 0.05° respectively. Therefore, the minimum sensible angular tolerance should be 0.05°. However, the resolution with which the angular misalignment can be measured (and hence the resolution of the applied correction) is determined not by the gimbal mount, but the measurement conditions themselves, including the acoustic field. For example, the angular misalignment in the Abt_Y rotational axis is determined from the equation:

$$\Delta\theta_{Abt\_Y} = \tan^{-1}\left(\frac{x_2 - x_1}{z_2 - z_1}\right)$$

Assuming the Find beam max scan increment was set to 0.1mm, and the "align to max" option was selected, the minimum (non zero) value for the numerator is clearly 0.1mm. To obtain a measurement resolution equal to the minimum possible tolerance of the gimbal (i.e. 0.05°), the inter-planar separation must be:

$$z_2 - z_1 = \frac{0.1}{\tan(0.05)} = 114.6mm$$

Such a large inter-planar spacing may not be possible depending on the configuration of the system and the properties of the acoustic field used. It should be noted that the algorithm assumes that the Find beam max process is finding the acoustic beam axis (i.e. that there is a maximum in acoustic intensity on the acoustic axis), this cannot be assumed in the near field of the transducer, or at all distances from a focussed transducer.

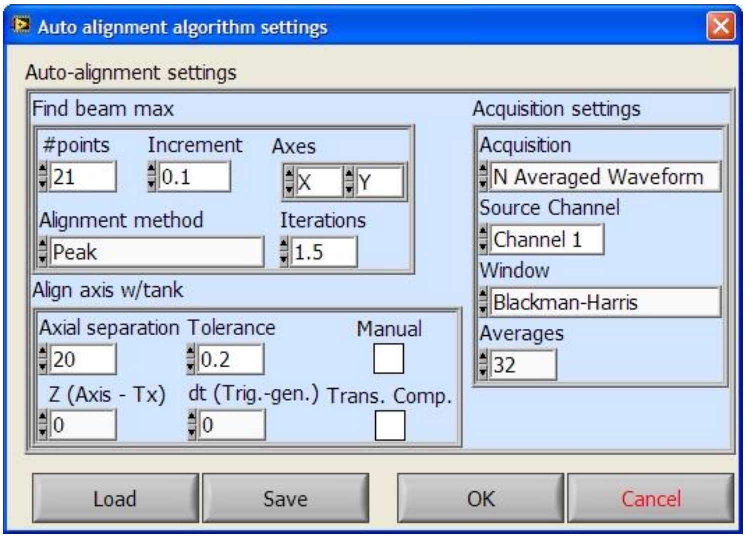


Figure 8 Auto alignment algorithm settings for align beam w/tank

Move to dt

The "Move to dt" button allows the user to position the hydrophone/transducer at a given time of flight for the acoustic signal. To achieve this, several conditions must be met.

1. The acoustic signal must be a pulse or tone burst, not CW.
2. The trigger signal supplied to the oscilloscope must correspond with the generation of the acoustic pulse.
3. The acoustic tone burst should be clearly visible (preferably expanded) on the oscilloscope.
4. TDC must be enabled (to at least "Z axis only").

When performing this operation, the system first finds the current time delay to the first peak/trough of the acoustic pulse whose amplitude is >15% of the peak amplitude, the difference between the target time delay and the current time delay is then calculated and converted to a distance to move in the Z direction. The system then moves the appropriate amount and checks the position of the peak. The process is repeated until the time delay is within the "tolerance" set when initiating the alignment.

Warning – The conditions above must be adhered to exactly when using this feature. Failure to do so could result in damage to the hydrophone or transducer as the system will make incorrect assumptions about the distance between the source and the target.

Home all

The “Home all” command is only available on systems using linear magnetic encoders and where an index reference sticker has been applied to the axes. In this case, pressing the “Home all” button allows the user to move the system to the fixed reference position and reset the co-ordinate system to “Absolute” (relative to the fixed reference). A dialogue is displayed which allows the user to select which axes to “home”. Only if all linear axes are homed is the system considered to be in “Absolute” position mode. When homing all axes, the system will home each axis in turn.

When homing, the system will move the homing axis in the negative direction to find the indicator sticker. If the carriage is already on the negative side of the reference marker, the system will move until it hits the negative limit and then search in the positive direction. It is therefore vital the limit switches are correctly positioned.

Reset zero

The **<Reset Zero>** button allows the user to make the current position the “zero” of the co-ordinate system for the current session. Pressing this button will return the system to “Relative” position mode.

Do AGC

The **<Do AGC>** command will cause the scope to set its vertical settings on the “Measurement Channel” such that the acoustic signal fills 6.5 major divisions in the vertical sense and is centred on the display.

Redefine position

The **<Redefine position>** command enables the user to redefine the co-ordinate values in the position display. Any or all axis position can be modified at any time. Doing this will cause the system to enter “relative” position mode

Acquiring waveforms

Acquisition of single waveforms is carried out via the **<ACTION→Simple acquisition>** action. The “Simple acquisition page (shown in Figure 9) allows the user to acquire a single waveform, an “N averaged waveform”, or a “Power Spec. FFT” of the selected source channel. Once acquired, the waveforms can be stored to disc in the **<Simple acquisition directory>** by clicking **<Save to file>**.

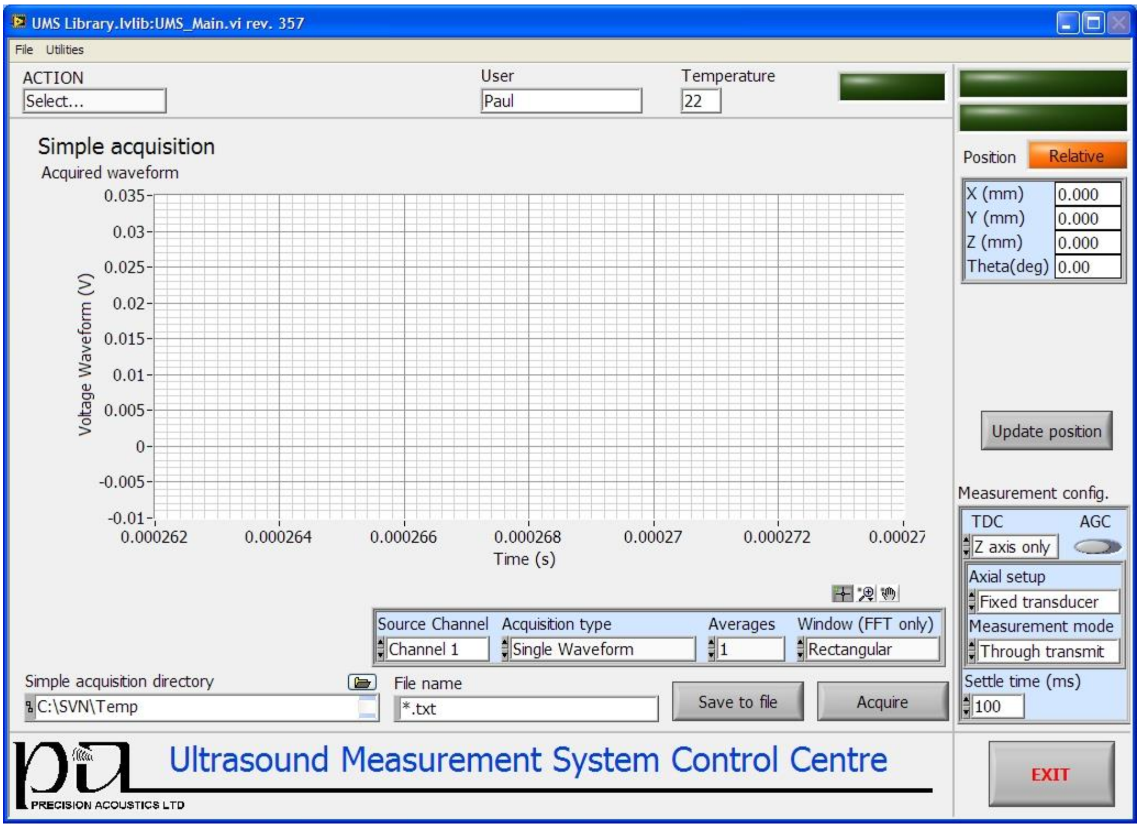


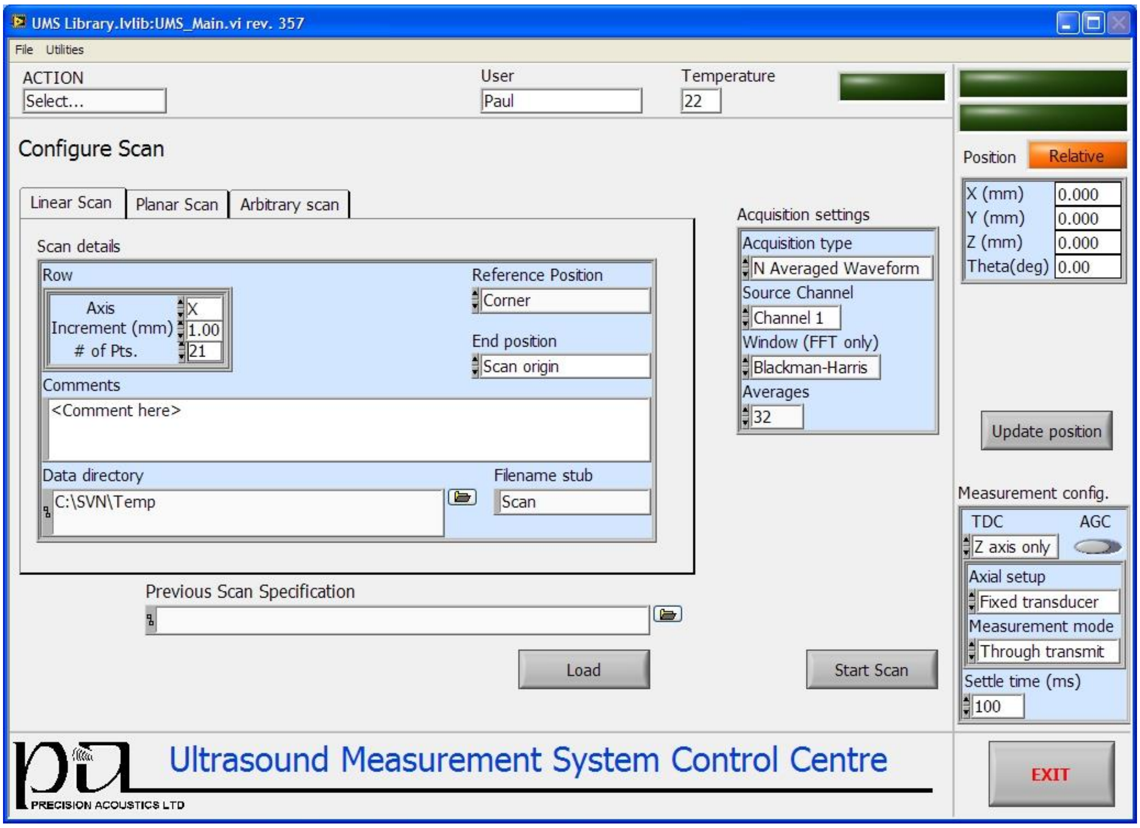
Figure 9. Simple acquisition page

Data file format

All waveforms acquired using the UMS software, either individually or through scanning, are saved as ASCII text files. Each waveform file comprises a header section containing information from the measurement information data and a data section which identifies the type of data contained within the file and then lists the data. A more detailed description of the waveform file structure is available on request. However it is typically assumed that all data viewing and post processing will be done through the supplied post-processing software.

Scanning

The UMS system can perform 3 types of scan – Linear (i.e. 1D), planar (i.e. 2D) or arbitrary (following a user generated array of co-ordinates). Scan configuration is accessed via **<ACTION→Scan>**, the configuration page is shown in Figure 10.



Linear (1D) scans can be performed along any individual axis of the UMS system. The user selects the axis to scan, the spatial increment of the scan (mm for linear axis scans, degrees for angular scans) and the number of points within the scan. The starting point of the scan is determined through the **<Reference Position>** control within the "Scan details" section. The options are either "Corner" or "Centre". If corner is selected, the scan will start with the current position as the first acquisition point. If centre is selected, the start point will be calculated such that the current position is at the centre of the scan. Note, that if an acquisition point is required at the current position, then an odd number of points should be entered when configuring a centred scan. The position to which the system moves once the scan has complete is set using the **<End position>** control. Options include the scan origin, the centre of the scan, the maximum of VSI or the final point of the scan.

The directory used to store the scan data is selectable (the default value can be set in the preferences section) as is the filename stub applied to each of the scan files. A scan specification file (*.ssf) is created when the scan commences and saved in the same directory as the scan data. This file contains the settings used for the scan and is used by the post processing suite. Previous scan settings can be loaded in from the ssf file by entering the file path in the **<Previous Scan Specification>** control and pressing **<Load>**.

As with the automated alignment procedures, the data acquisition settings to be used for the scan are set in the **<Acquisition settings>** control.

Planar (2D) scans are configured in the same way as linear scans (on the Planar scan tab of the configure scan page). In this case, the user configures both the **<Row>** and **<Column>** of the scan. The "Row" is the axis which is incremented for each measurement, whereas the "Column" axis incremented after each row is complete.

Arbitrary scans require the user to upload a spreadsheet file of co-ordinates to the software or manually enter a set of co-ordinates via the control on the "Arbitrary scan" tab. Only X,Y,Z co-ordinates are supported. The co-ordinates file should be a tab delimited text file with the following structure:

N (no. of points in file)	X	Y	Z
0 (point number)	X_1	Y_1	Z_1
1	X_2	Y_2	Z_2
⋮	⋮	⋮	⋮
N	X_N	Y_N	Z_N

Prior to commencing a scan, the user can enter details of the device under test and the test equipment being used by pressing "Set device ID".

During a scan, UMS displays the current progress, including the number of points remaining and an estimate of the time remaining. Depending on the type of scan running, UMS will also display the last acquired waveform and a 1D or 2D profile of the voltage squared integrals of the already acquired waveforms, as shown in Figure 11. In the case of an arbitrary scan, the system will display the progress as a 1D profile. At any point during the scan, the **<Abort Scan>** button can be pressed to halt the scan. In this case, a dialogue is shown allowing the scan to be resumed or terminated. If the scan is resumed it will continue without missing any data points. If it is terminated, the system will return to the scan origin position.

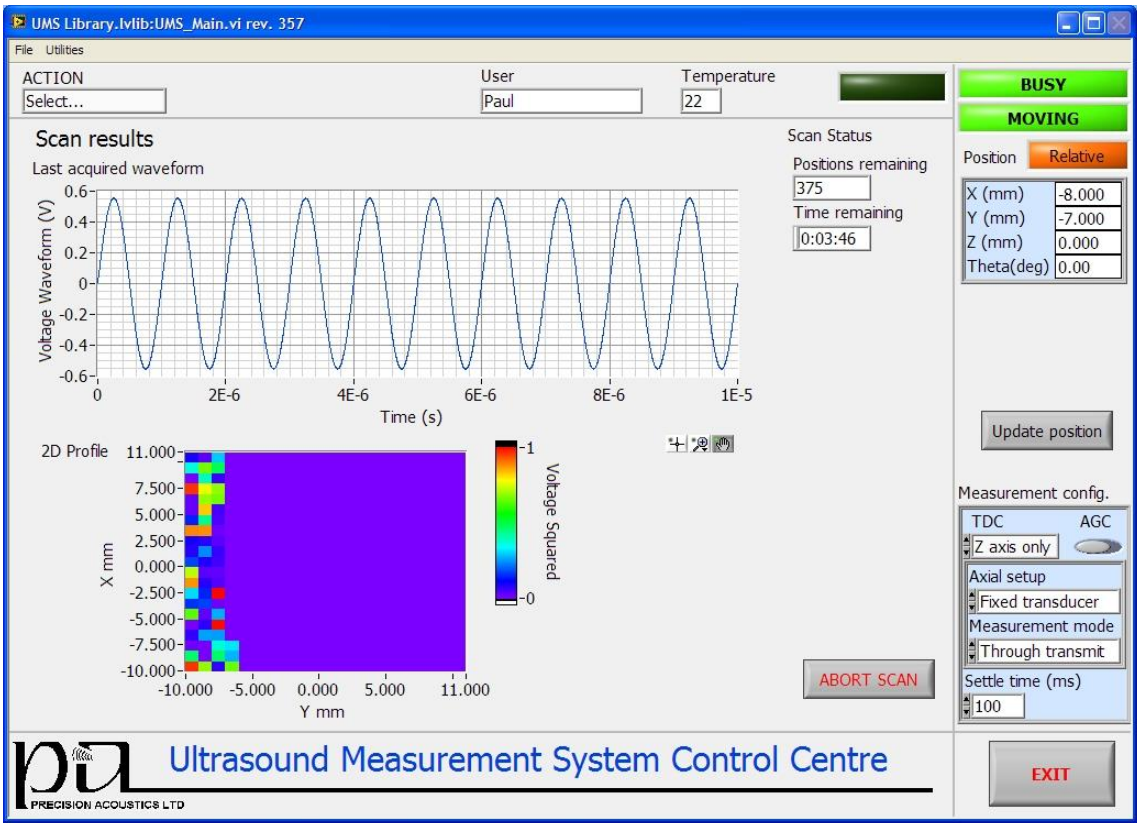


Figure 11. Progress of a planar (2d) scan

Scripting

The **<ACTIONS→Scripting>** feature of the UMS system allows the user to perform a predetermined sequence of automated measurement tasks, i.e. alignment, scanning, moving and configuration without any intermediate user input. Scripts are created through the scripting UI accessed on the Scripting page, which also displays a list of previously written scripted measurement tasks. The scripting UI is shown in Figure 12. The left hand side of the display shows the list of operations making up the measurement task. The tab control to the right allows the user to customise each of the tasks. New operations are added to the list by choosing from the **<Operation>** drop down list and then clicking **<Add>**. Operations are customised by selecting them in the main list, setting the values in the tab control to the right and pressing **<Update Tree>**. The **<Move Up>** and **<Move Down>** buttons move the selected operation up or down the tree. The script can be given a description which is displayed in the scripts list within the main UMS GUI. Once complete, the script is saved to file (by clicking **<Save>**) and the user can return to the main UMS software by clicking **<Finish>**. The created script can then be run by selecting it from the list.

A script progress dialogue shows a list of the tasks in the script and highlights the current operation. The UMS display will also update as individual tasks are performed (i.e. the scan display page will be shown when a scan is running).

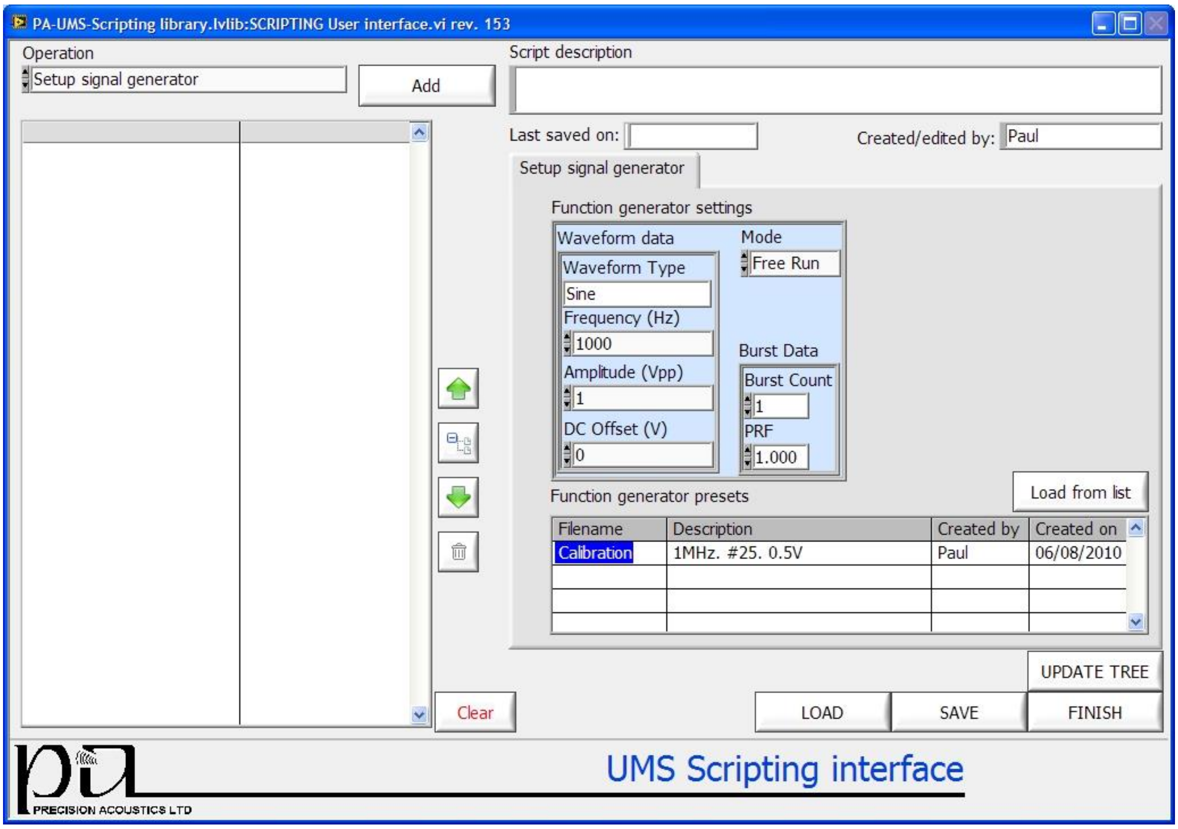


Figure 12. UMS scripting interface

Configuring the UMS system: Setting Preferences

The **<ACTIONS→Set preferences>** action takes the user to the preferences screen. Preference setting is split between five sub-screens:

BASIC CONFIGURATION

Here, the user configures basic interface options options including the **<Default User>**, **<Measurement config.>**. The visibility of the automatic function buttons on the move page can also be set (to prevent users from using the advanced functions if desired). From here, the system can also be configured to recall the co-ordinate of the current position on power up. With this option checked, the last known "position" indicator will be updated to the last known co-ordinate of the system on power up.

DATA DIRECTORIES

Here the user can set default data directories for simple acquisition data, script files, reference hydrophone data and auto alignment settings.

AUTO ALIGNMENT SETTINGS

Here the user can set the default parameters for auto alignment procedures, including data acquisition settings.

PERIPHERAL CONFIGURATION

This page is used to configure peripheral devices (oscilloscope, function generator, thermocouple). The user can use this page to connect and disconnect devices once the software is running and also set the default device configuration. All devices can be set to “simulate if absent” to preview the software functionality or test scripts without the system being connected.

The system can maintain a list of different hardware devices used by the system. For example, if more than one function generator is used with the system, the details for each can be saved by the system and recalled when needed. To add a device to the list of available devices, click **<Edit list>** for the appropriate device type.

An instrument driver file is required for each device used; the list of currently available device drivers can be obtained by contacting technical support. If it is necessary to control a device not currently supported, additional drivers can be written but a fee is usually charged to cover development. Please contact technical support for more details if required.

AXIS CONFIGURATION

This page allows the user to configure the moving axes of the system. The user can set which axes are present in the system and which axes to simulate.

The advanced settings in Axis configuration **SHOULD NOT BE CHANGED** except on discussion with PA. Changing these settings may affect the way the system moves.

If the configuration file indicates that a specific device should be present but communication or initialisation fails, an error message indicating which device has failed to initialise will be displayed on start-up and the software will display the hardware configuration page. Should this occur, depending on which device fails to initialise, you may need to manually connect the peripheral devices once the appropriate corrective action has been taken.

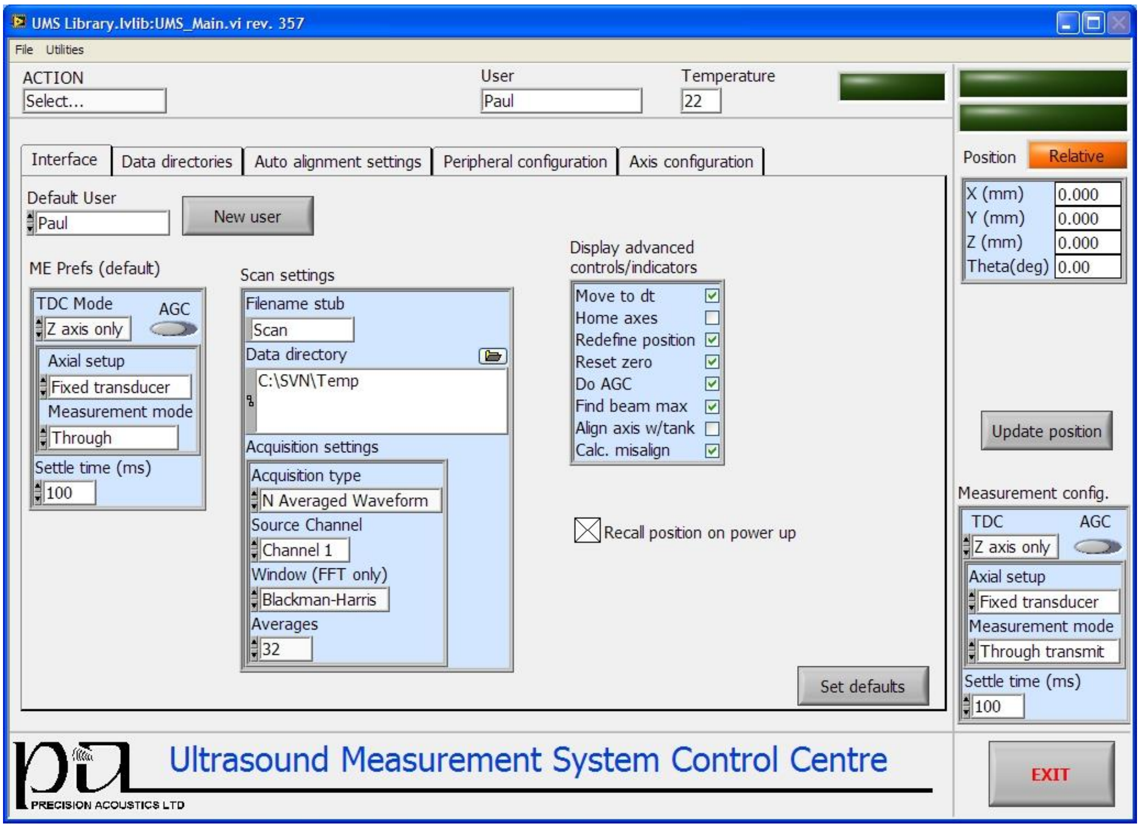


Figure 13 Basic configuration page in preference setting

TROUBLESHOOTING

Whilst every effort has been made to test and debug UMS software, it is designed to present an error dialogue to the user in case of internal errors. In certain cases the error may be considered "Fatal" and the software will shut down. If an error is displayed that does not resolve itself, please make a note of the full text (a screen shot may be useful) and contact us for help.

Common solutions

This section provides a list of things to check in case of problems with the system.

Initialisation errors

If the system presents an error on initialisation read carefully the error message as it will identify which piece of equipment failed to initialise correctly.

Things to check

1. **<VISA Resource name>**

This the reference name for the communications interface for the device in question. If the device is connected via GPIB the name should be of the format GPIB{*n*}::*m*::INSTR where *n* is the GPIB controller (within the host PC – typically *n=0)* and *m* is the GPIB address of the instrument (this can typically be checked/set on the device itself). For a Lecroy Oscilloscope using Ethernet communication it should be of the form vicp::xxx.xxx.xxx.xxx where the xxx's correspond to the device IP address on the network. Devices connected over a serial interface (e.g. the main linear axes) should be of the form COMX where X is the COM port number of the interface on the PC, this may be checked using the Device Manager within windows.

2. **<Device driver>**

Each connected device requires a driver. Check that the correct device driver is selected for each device type. The **<Device driver>** control automatically lists all drivers for each device type that are installed on the system. If the driver for your device is not listed, please contact us. The driver for the "Stepper system" and "Gimbal mount" is not user selectable.

3. Power and connectivity

Check all devices are powered on and connected to the host PC. For Ethernet devices (such as some Lecroy oscilloscopes), ensure both the host PC and the device are connected to the network and that the network is properly configured.

Waveform acquisition errors

The most common error to occur on acquisition of a waveform is a timeout. This can occur if the scope triggering is not well configured. If the scope is not triggering, it is not acquiring data and the UMS software will timeout. Failure to trigger can result if the oscilloscope is configured to trigger from the acoustic signal being measured – during a scan the signal amplitude can fall below the trigger threshold causing an error. To minimise the risk of scope triggering errors it is advisable to use an external trigger from the function generator (or equivalent).

Additionally, ensure the correct **<Source channel>** is set when acquiring waveforms.

Function generator configuration errors

The function generator control given by UMS is designed to include the functions typically required for acoustic measurements. However, not all function generators support all of the commands provided by UMS. If a non-supported command is sent, a notification is displayed to the user.