

QPix2 XT

Robot Manual



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Introduction

Genetix QPix2 XT

The **QPix2 XT** provides the optimum in colony picking technology. Designed around a highly accurate linear system (x, y-axis) and ball-screw system (z-axis), the **QPix2 XT** combines speed, precision, versatility and durability to offer an invaluable tool for any laboratory engaged in high-throughput pharmaceutical, genomic or bio research colony picking.

The **QPix2 XT** is a high-speed, automated picking system comprising a microplate stacker and the extended **QPix2** picking system.

The microplate stacker (Well plate stacker) has 2 cassettes and each cassette can hold up to 70 well plates.

The new patented picking actuator has greatly increased the speed of the picking routine. Once located using a CCD camera, colonies or plaques are picked from **QTrays** by a 96-pin **Picking Head** and then inoculated into pre-filled 96 or 384 well plates.

Custom written Windows® based software, **QSoft**, allows you to easily configure routines and offers easy switching between software programs.

A number of additional applications are also available with the **QPix2 XT**.

The 96 and 384 pin **Gridding Heads** allow samples of DNA or bacteria to be gridded at high density onto large (22.2cm x 22.2cm) nylon membranes from 96 or 384 well plates.

Replication of colonies can be carried out from 96 to 96 well plates and from 384 to 384 well plates using the 96 or 384 pin **Gridding Head**. Compression and expansion of DNA libraries is also possible.

The 96 pin picking head will **ReArray** selected clones of interest from a library into **new** well plates.

In order to optimize the performance of the **QPix2 XT**, Genetix has developed a range of plastic consumables for use with the machine. This began with the Quadruple density microplates - the origin of the 384 well format - and has continued with **QReps** (replicators) and **QTrays**.

Picking

The **QPix2 XT** is capable of automatically picking in excess of 4,000 colonies per hour. This is made possible using an integrated vision, detection and analysis system combined with novel software and a (patented) 96 pin picking head assembly, both custom designed by Genetix.

You are required to specify picking thresholds relating to the intensity (color), roundness and proximity of clones. The **QTray** is then imaged in 35 frames, via a CCD camera, and the information obtained analyzed according to the user-defined parameters. A correction factor within the software ensures that any colonies which appear in more than one frame are only chosen once, and therefore double picking of colonies does not occur.

The **QPix2 XT** can also pick from standard Petri dishes or OmniTrays™ using the appropriate optional holders.

Colonies are picked using a unique patented picking head assembly with a 96 pin picking head. Once all 96 pins have picked colonies they are inoculated into pre-filled 96 or 384 well plates. The picking head is then automatically sent to the wash station where it is cleaned and sterilized ready for the next cycle.

Notes: The robot is strictly for research use only and is not intended or recommended for the diagnosis of disease in humans or animals. If the robot is used in a manner not specified in this manual the protection provided by the equipment may be impaired.

Technical Specifications

QPiX2 XT

Manufactured by Genetix Ltd (UK)

Dimensions:

Size:	2850mm (width including stacker and PC table) 730 mm (depth) 2050 mm (height on table from floor to top of stacker cassette)
Weight:	Robot (including well plate stacker and 6 empty cassettes) – 246.5 kg Table (including computer unit) – 165 kg Total Assembled – 411.5 kg

Compressed Air Supply:

Minimum Pressure:	6 bar
Minimum volume:	80L/min

Operating Environment:

Indoor use only	
Temperature:	10°C to 40°C
Humidity:	20 to 80% non-condensing
Altitude:	Up to 2000M
Mains supply:	+/- 10% Rated Voltage
Transient overvoltage:	Installation Category (Overvoltage category) II
Rated pollution:	Pollution degree 2

Electrical Supply:

Voltage is factory set

European:

Voltage:	210 - 250V AC 45-66 Hz single phase		
Power:	300VA		
Current:	3A Max		
Connections:	IEC Input	-	Robot Mains
	IEC Output	-	PC
	IEC Output	-	Monitor
Fuses:	Input	-	F1 – T10A - Robot
	Output	-	F2 - T5A - Computer and Monitor

USA/Japan:

Voltage:	100 – 125V AC 45-66 Hz single phase
Power:	300VA



Current:	3A Max		
Connections:	IEC Input	-	Robot Mains
	IEC Output	-	PC
	IEC Output	-	Monitor
Fuses:	Input	-	F1 – T10A - Robot
	Output	-	F2 - T5A - Computer and Monitor

General:

Halogen drier:	When the Robot is operating, additional Power will be consumed by the Halogen Drier. Maximum duty cycle 50%, actual duty cycle is determined by operator selected parameters. Halogen900KVA.
Inrush current: “motor”	20A 100mS Max. Due to the large inrush current the QPix should be supplied by a rated (class C) circuit breaker to avoid nuisance tripping. RCCD's and ELCB's are not recommended.
Air compressor:	Note that the optional external air compressor is not included in this assessment
Supply:	It is recommended that the QPix is powered from a dedicated ring main or spur as appropriate to local regulations.

Installation

QPix2 XT Installation

Installation is to be undertaken only by Genetix approved personnel.

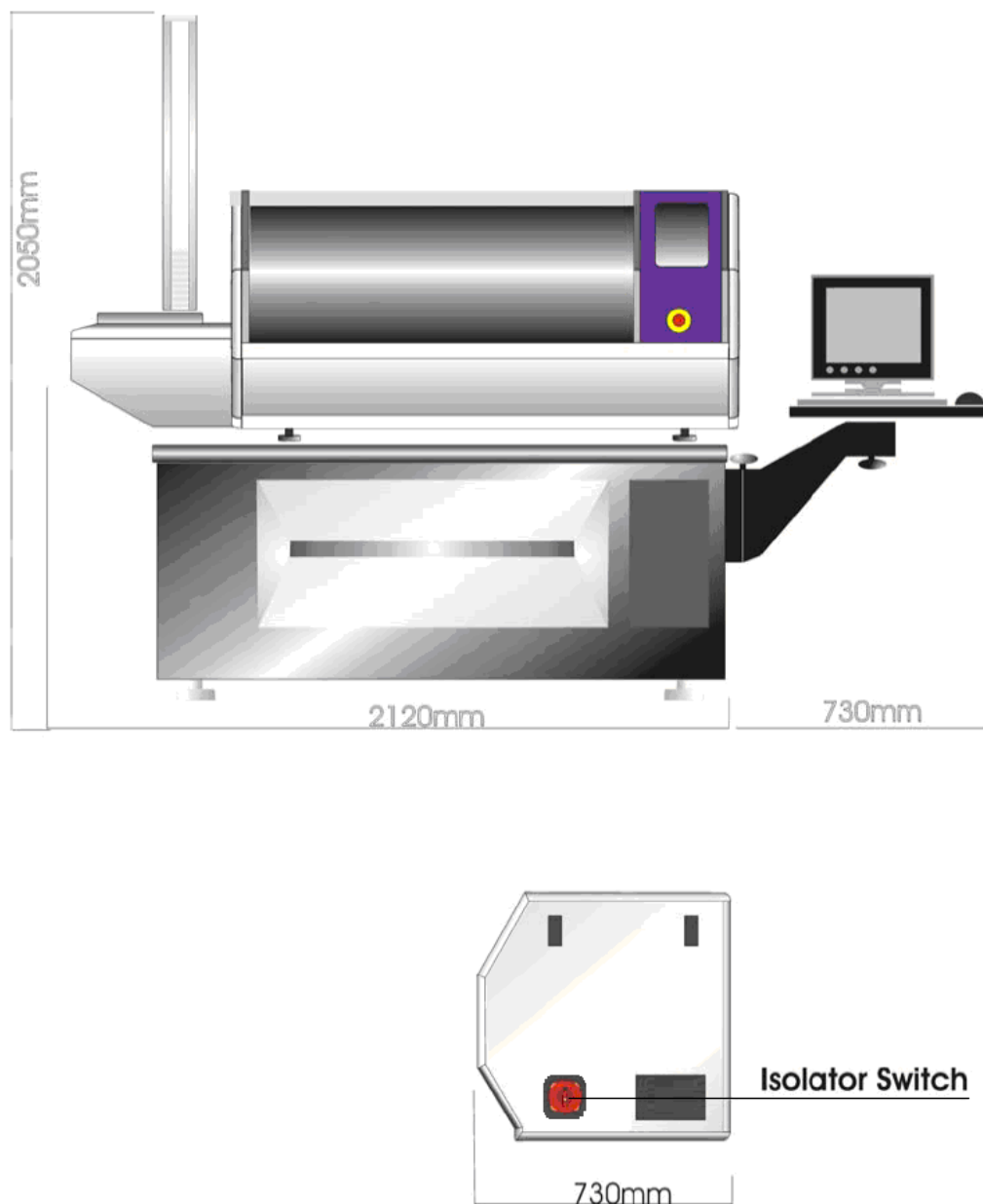


Figure 1:
QPix2 XT dimensions

View of QPix2 XT connector panel

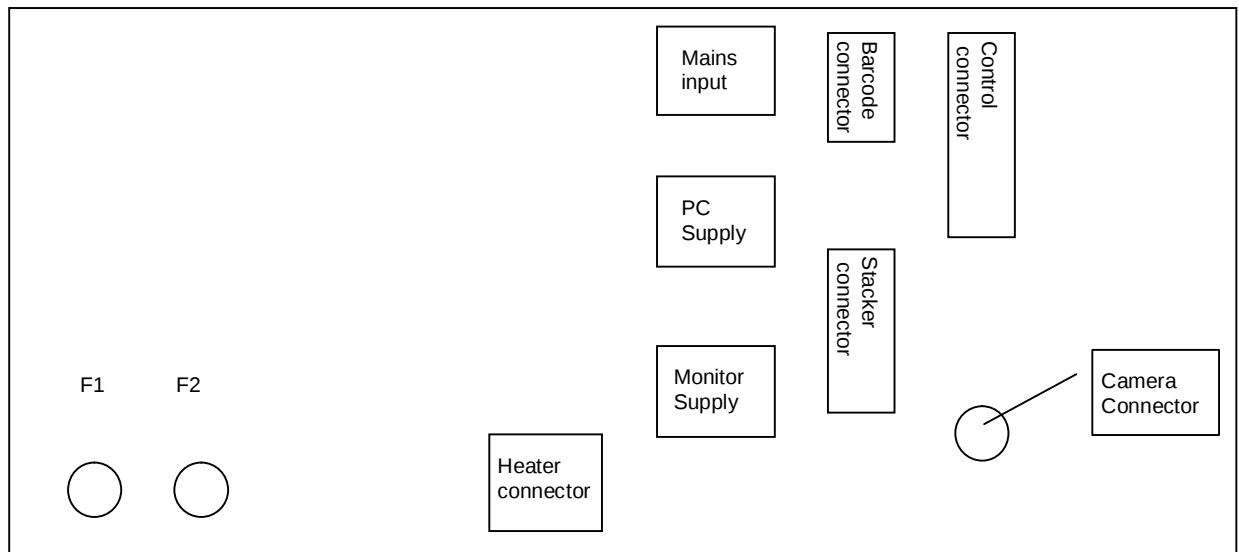


Figure 2:
QPix2 XT connections

Health and Safety

Note

Before using the robot, it is very important that you have read this manual and have understood all the safety instructions.

Prior to using the robot, please make sure that you have been through the robot Pre-Power-Up checklist. This checklist ensures that all moving parts on the robot are correctly situated in their datum positions.

Then follow the procedures as set out in the Power-Up section.

Transport and Storage

The robot must be stored and transported in temperatures within the range -25°C to $+55^{\circ}\text{C}$.

Lifting Points

The machine should not be moved after installation. However, in the unlikely event of it needing to be moved then standard lifting gear is adequate, but only in the presence of a Genetix approved engineer.

The robot should be moved into position using appropriate handling equipment such as forklift trucks or dolly trucks. The machine should be properly balanced on the forks prior to lifting.

External Covers



Warning – If any of the external covers on a bench top robot are removed the power supply is not automatically interrupted. If it is necessary to remove any of the external covers you must ensure that the power is switched off first and do not attempt to use the robot until the covers are replaced.

Caution - Risk of Electric Shock - More than one disconnect switch may be required to de-energize the equipment before servicing.

Safety Features

Isolator Switch:

Turns on power to robot (the location of the isolator switch is shown on the Installation diagram). If the robot has a status panel, the lights indicate whether main power is on.

QTray Stacker Isolator Switch: (MegaPix robot only)

Located on the front-right of the QTray Stacker, turning this switch off will isolate power to the QTray stacker but leave the robot power on.

Door(s):

The machine will not run with the door(s) open. If a door is open, a mechanical switch prevents the machine from running. This switch should never be tampered with, as it serves two purposes:

- It prevents the motors from running and therefore the potential of any physical damage.
- It disables the UV light therefore preventing the risk of damage from UV radiation.

The door is made from acrylic, and so prevents UV light from passing through during operation.

UV Light:

Some robot models have a UV light fitted for sterilization. This is a 30W linear discharge lamp with a sharply defined output at 253.7nm making the lamp an efficient source of germicidal radiation.

Emergency STOP Button(s):

The location of the Emergency Stop button(s) is shown in the Installation diagram). Striking an Emergency Stop button will immediately stop the machine and cut power from the drives. The button must be pulled out before the machine can be restarted.

Note: If the PC is powered from the robot, power to the PC will also be cut and current data will be lost.

Electrical Safety

The robot must be connected to a properly earthed power outlet to protect users from the risk of electric shock. The main chassis of the machine is earthed together with all associated electrical components. Do not remove any of the fixed covers, as there are no user serviceable parts inside. All internal work should be referred to Genetix approved service personnel.

Caution: Risk of Electric Shock - More than one disconnect switch may be required to de-energize the equipment before servicing.

In the event of a liquid spillage into the base cavity of the robot, the power supply should be disconnected at the mains before any attempt is made to clean up the spillage.

There should not be any spillage from the Wash Bath in normal use with the Wash Station correctly set up. However, spill trays have been fitted where appropriate.

Drive Safety

Be aware that the motors use high-powered magnets.

The linear drive units and encoders are delicate so great care should be taken with them.

The Pre-Power-Up checklist should be followed before every routine in order to prevent serious damage to the robot or any of its constituent parts.

It should be noted that when the robot has reached the end of a routine, or if the drives have stopped due to the door being opened, there is still power to the drives. Because of this, caution must be exercised when working within the cabinet e.g. when changing plates.

Datuming mode

Be aware of moving parts when in datuming mode.

When the instrument is in datuming mode the door switch override key is inserted into the door switch to enable the **QPix2 XT** to run with the door open.

When the **QPix2 XT** is in datuming mode, a secondary door switch will cause a sounder to operate, warning the user of enabled drives.

Hot Air/Halogen Dryer

If the robot has a dryer fitted, be aware that the casing may become hot during the wash cycle.

Noise Levels

During normal operation the level of airborne noise emitted by the robot will not exceed 70db measured at a distance of 1 meter.

Cleaning the machine

The bed of the machine should be cleaned before and after each routine that is performed, using 80% ethanol or dilute detergent and a soft cloth.

Organic solvents and abrasive cleaners should not be used, as they will damage the surface of the bed.

Specific cleaning instructions are described in the **Maintenance** section of this manual.

Service and Maintenance

We would strongly recommend that maintenance be carried out regularly and by a Genetix-approved service engineer.

Maintenance contracts can be obtained from Genetix, contact sales@genetix.com.

Initial Operation

System Features

The **QPix2 XT** is constructed within a welded steel framework. The well plate stacker is attached to this framework on the left hand side. The outer measurements are given in the [Technical Specifications](#) section. Be aware that these dimensions do not allow for opening the robot doors.

The lifting door on the front of the machine, monitored by a mechanical interlock, contains the working volume of the machine.

The machine contains 2 microtiter stackers (optionally 3) and 2 bioassay trays or 6 gridding filter blocks. It can also contain up to 3 wash baths. The wash baths clean the picking head between cycles in order to eliminate cross-contamination. There is a halogen dryer which is used for drying the picking head after it has been washed.

The Z ball-screw drive carries a unique actuator system that accommodates the head. This system allows for easy exchange and set-up of the head. Removing a head is achieved by undoing the thumb screw which secures the head to the actuator assembly, and sliding the head backwards out of its holster. Fitting a head is simply the reverse process.

Pre-Power-Up Checklist

- Check that the Emergency Stop button (Red) has been primed (pulled out).
- Check that no loose items have been left on the bed of the **QPix2 XT**.
- Check that all motor tracks are free of obstruction.
- Check that the main x, y robot axes are roughly in the centre of their respective travel positions. The axes need to be away from their respective end-stops on 'start up' in order that they may reference themselves correctly to their 'home' positions.
- Check that the lifting door on the front of the robot is closed.

Power-Up Procedures

Note: The computer will power on with the QPix2 XT.

- Turn on the power supply to the compressor.
- Turn main isolator switch (situated on the right hand side of the **QPix2 XT**) to the **on** position (1). This isolator switch is lockable and clearly labeled. The red 'Power On' indicator (on the front panel of the **QPix2 XT**) illuminates. If the system fails to 'power on', it is likely that the emergency stop button has not been primed.
- Check that the air supply indicator (on front panel) is on.
- Once the computer has booted up (check by moving the mouse on the screen), click on one of the application icons, the three axes will sequentially go through their 'Initialize drives' routine. This enables the drives to find their respective datum positions. The **QPix2 XT** must be allowed to complete this process without interference to ensure that there is no damage to the **QPix2 XT** or its ancillary equipment.
- Once the **QPix2 XT** has finished its calibration procedure, the x, y, z axes should return to their **home** positions. The **home** positions can be varied according to your needs.

It is important that you check this every time you go through a system reset or when a 'Start-Up' is initiated.

Shutdown procedure

- Exit from the application by clicking the **Done** button on the main setup screen.
- Close down Windows – Click the **Start** menu at the bottom of the screen then choose **Shut Down**. Make sure that **Shut down** is the selected option and click on **OK**.
- Switch the robot isolator switch to the off (0) position.
- Turn the power off at the mains.

Opening the door during a run

As part of the Safety systems, the door operates the emergency braking system, therefore the door cannot be opened whilst the "Robot working" light is illuminated.

When the "Robot working" light is illuminated, the **QPix2 XT** motion system is enabled and ready to move. Opening the door whilst the robot is working will cause the **QPix2 XT** to go into emergency stop mode, essentially the same as striking the emergency stop button.

If the "Robot Working" light is extinguished the door can be opened. If the **QPix2 XT** is running and the door is required to be opened, the user must press "Pause" then "Open Door" in the script window.

The script will home then disable the drives.

After opening & closing the door "Close Door" should be pressed, the drives will then be re-enabled and continue from where they left off.

Note: If the door is opened without pausing and clicking 'open door' or before the drives have reached the home position, an error will occur that may require the **QPix2 XT** & the PC to be shut down for 30 seconds and then restarted.

Datuming mode

To enter the Datuming mode for the **QPix2 XT**, the door switch override key has to be inserted into the door switch.

The **QPix2 XT** can run with the door is open but a secondary door switch will cause a sounder to operate, warning the user of enabled drives.

Configuration Guide

Configuring the Robot

Before the robot can be used it is necessary to configure it (tell the software what component objects we have and where they are.)

The configuration settings can be accessed from any application and are held in a central database (namely **QSoft.mdb**).

Configuration entails entering all required objects and then datuming all the co-ordinates for the various objects on the workbed. This procedure needs to be carried out:

- On first receipt of the machine (to be carried out by Genetix Personnel)
- On the addition or change of any objects to the workbed.
- If the drives have been realigned or subject to a knock.

The procedure for configuring the robot is as follows:

Configuration Screen

Due to the potential hazards of changing configurations, only approved trained personnel can change these settings.

Warning - Changes made to the Datum Points and/or Defined Objects affect the overall accuracy of the robot. The Datum Points and Defined Objects are accurately defined when your robot is installed and commissioned. We recommend that a backup of the master configuration file (**QSoft.mdb**) is copied and stored in a separate place. The facility for backing up the database is available on the Database tab. **Please take care over all further changes made!!** Any inappropriate changes to the 'Datum Points' and/or 'Defined Objects' could result in **crashes** to the robot Head. Also, to avoid possible **crashes** we advise that the robot is sent to the **Home** position after each change to a particular Datum Point.

To access the robot Configuration screen, click on the **Configuration** button on the toolbar or select **Configuration** from the **View** menu.

The robot configuration window will appear which comprises 5 main sections:

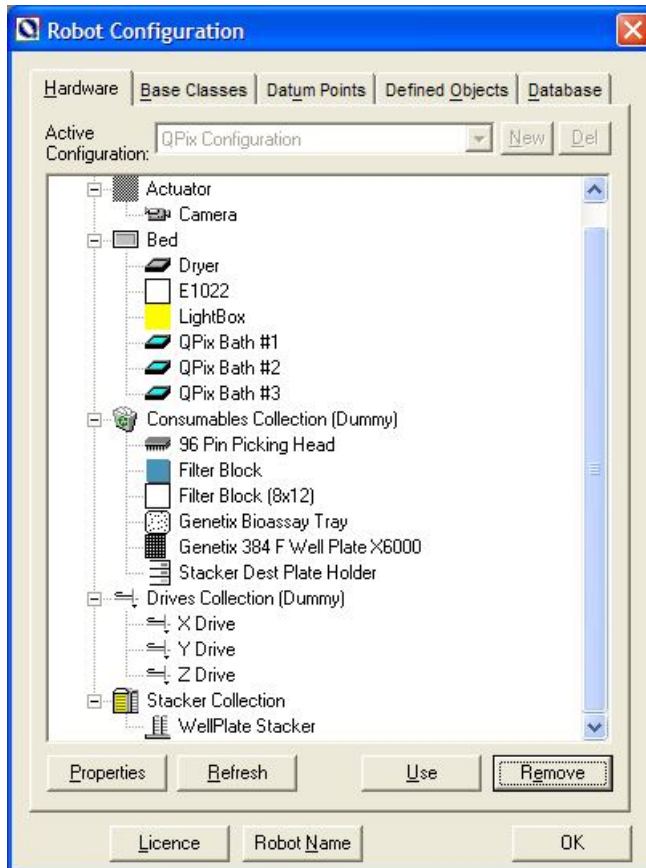


Figure 3:
Robot configuration screen

This facility is designed to allow qualified, authorized personnel to configure the robot Datum Points and Defined Objects very precisely to meet their own needs - so that each position can be fine-tuned to ensure optimum performance.

- **Hardware** – Software model representing the physical layout of the robot.
- **Base Classes** – Information pertaining to the creation/usage of each physical element (object i.e. bath, dryer, well plate etc) of the robot.
- **Datum Points** – List of Datum Points that comprise the locations (co-ordinates) of all Objects on the robot bed.
- **Defined Objects** – List of all Objects currently defined. i.e. bath, dryer, drives, well plates etc.
- **Database** - Provides a set of utilities for managing/maintaining the database.

Hardware

This tab displays the Software model that closely resembles the physical layout of the robot. You should not normally modify any details on this tab unless explicitly advised to by Genetix. The view displays the robot as the parent Object with 4 sections:

- **Actuator** – The Actuator represents the bottom of the Z Drive, which hosts the Camera, Pin firing mechanism and Head. (The head is not displayed in the Actuator section as it is regarded as a 'Consumable Object' i.e. can be changed at runtime and is not a fixed component of the robot)
- **Bed** – The Bed represents the work area of the robot and hosts the Baths, Dryer, Light Box and U Drive. (Note: Destination Plate Holders are not displayed in the Bed section as they are regarded as 'Consumable Objects' i.e. can be changed at runtime and are not fixed components of the robot)
- **Consumables** – Displays the Objects that are used when Datuming. This section DOES NOT display all consumable objects, ONLY those to be used when Datuming. There should be a Bioassay Tray, Destination Plate Holder, Head and well plate visible in this section.
- **Drives** – displays the 3 drives (X, Y and Z) used in the robot configuration.

Further options available on this tab are:

Properties

Displays the property sheet dialog relating to the highlighted object.

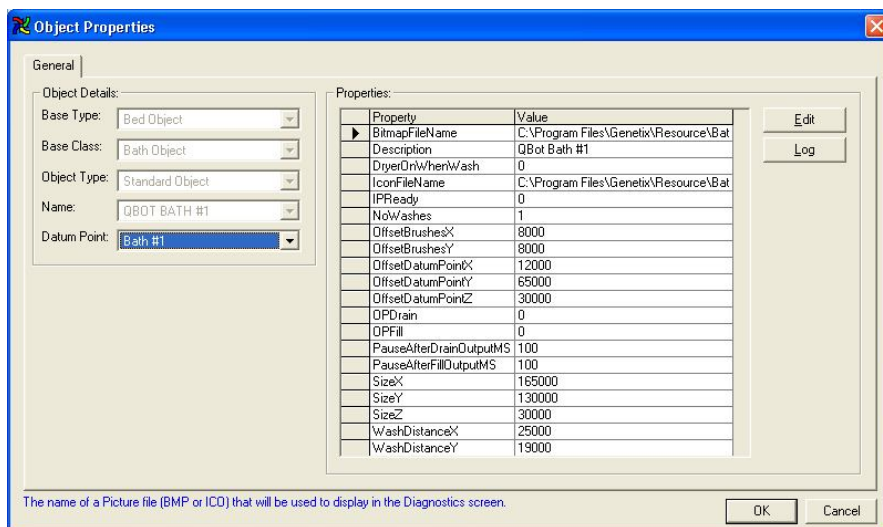


Figure 4:
Object properties dialog

Object Details - Displays the base details of the given object, short name and Datum Point if applicable.

Properties – Lists the properties that comprise the Object. A description of each property can be viewed at the foot of the dialog as you scroll through the list.

Edit – Displays the Edit Property dialog for the highlighted Property. For example:

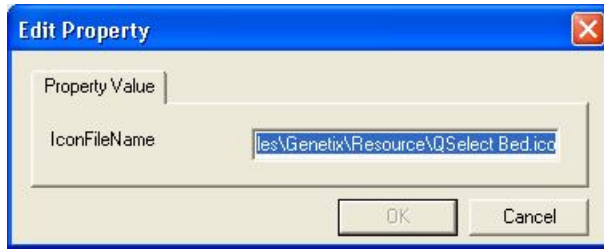


Figure 5:
Edit property dialog

Make amendments as applicable and select:

OK – to save and close the Edit Property dialog or

Cancel – to abandon and close the Edit Property dialog

Log – Stores a record of changes made to the properties of the selected object. A check box allows you to purge the log of all entries that are more than 21 days old.

OK – Saves the Object with any modified properties and closes the Object Properties dialog.

Cancel – Abandons any changes made and closes the Object Properties dialog.

Refresh – Configuration Data is loaded when the application starts. However if any object properties are changed, click the Refresh button to reload the configuration data with the changed properties.

Use – Displays available objects to be used in the current configuration. Do not use unless advised by Genetix.

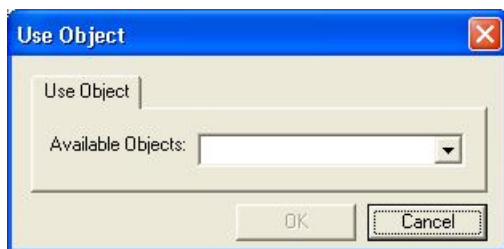


Figure 6:
Use object dialog

Remove – Removes the highlighted object from the current configuration. Do not use unless advised by Genetix.

License

Displays details of your license agreement, if you currently have a 'demo' simulation version of QSoft this will be displayed here.

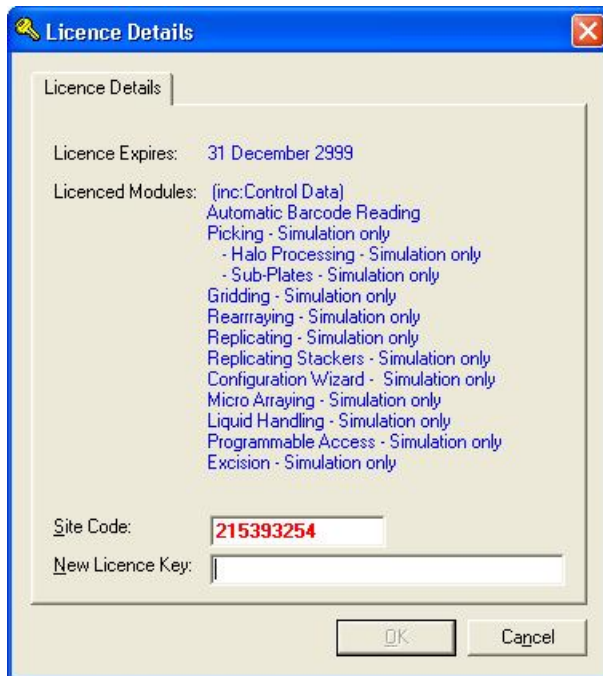


Figure 7:
Example of License Details screen

Robot name

Allows the user to give the robot a name.

Base Classes

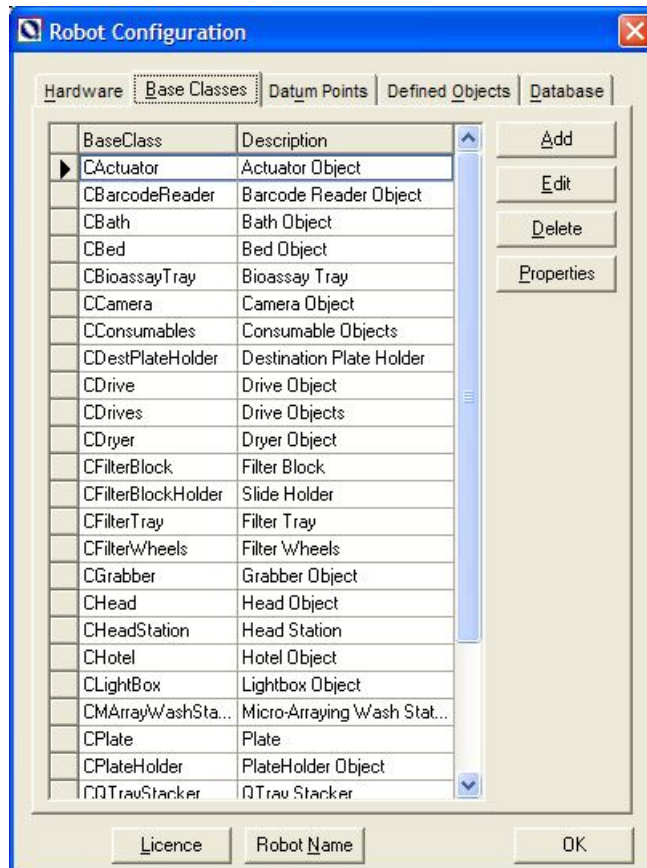


Figure 8:
Robot Configuration - Base Classes

This tab displays the Base Classes that comprise the blueprint for each individual Object defined in the Configuration. Do not modify data on this tab unless advised by Genetix.

Datum Points



Figure 9:
Robot Configuration - Datum Points

The Datum Points tab displays the Datum Points currently active for the robot. Datum Points are the physical location of various points critical to the accuracy of the robot.

When setting Datum Points, it is advisable to remove the Head until you are familiar with each individual Datum Point. Always make small changes and test the new positions frequently.



Be aware of moving parts when in datuming mode

When the instrument is in datuming mode the door switch override key is inserted into the door switch to enable the QPix to run with the door open.

When the QPix is in datuming mode, a secondary door switch will cause a sounder to operate, warning the user of enabled drives.

Drive Limits

In order to prevent any damage to the drives, it is necessary to set, in software, the minimum and maximum travel positions for the X and Y drives.

This is done by clicking on the Drive Limits (Min) and Drive Limits (Max) buttons and following the instructions on the respective Dialogue Boxes.

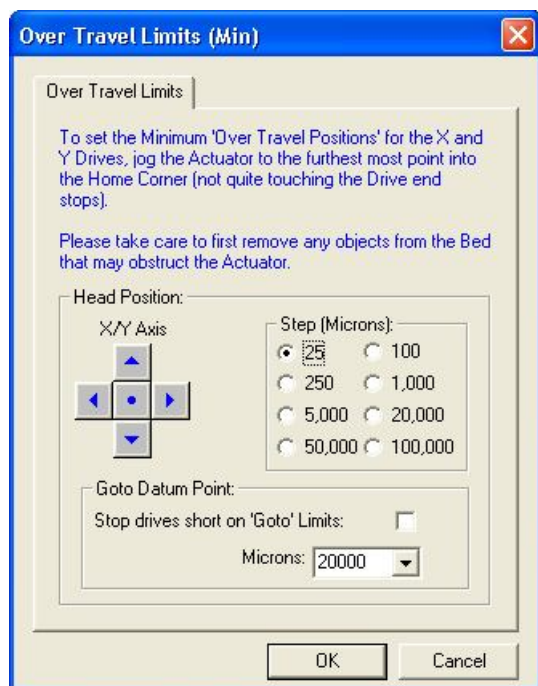


Figure 10:
Drive Limits dialog

Align Camera

The Align Camera option is found on the Datum Points Tab of the robot configuration screen.

A screen similar to the one in Figure 11 will be displayed.

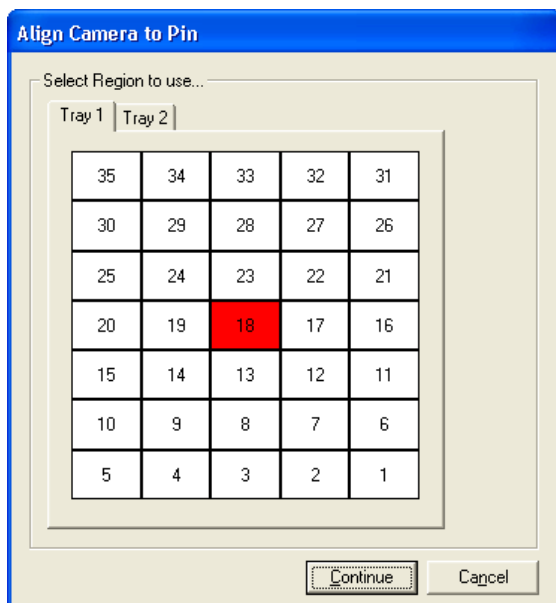


Figure 11:
Align Camera

Select the region to align the camera in then click on continue.

The following screen will appear (see Figure 12 below)

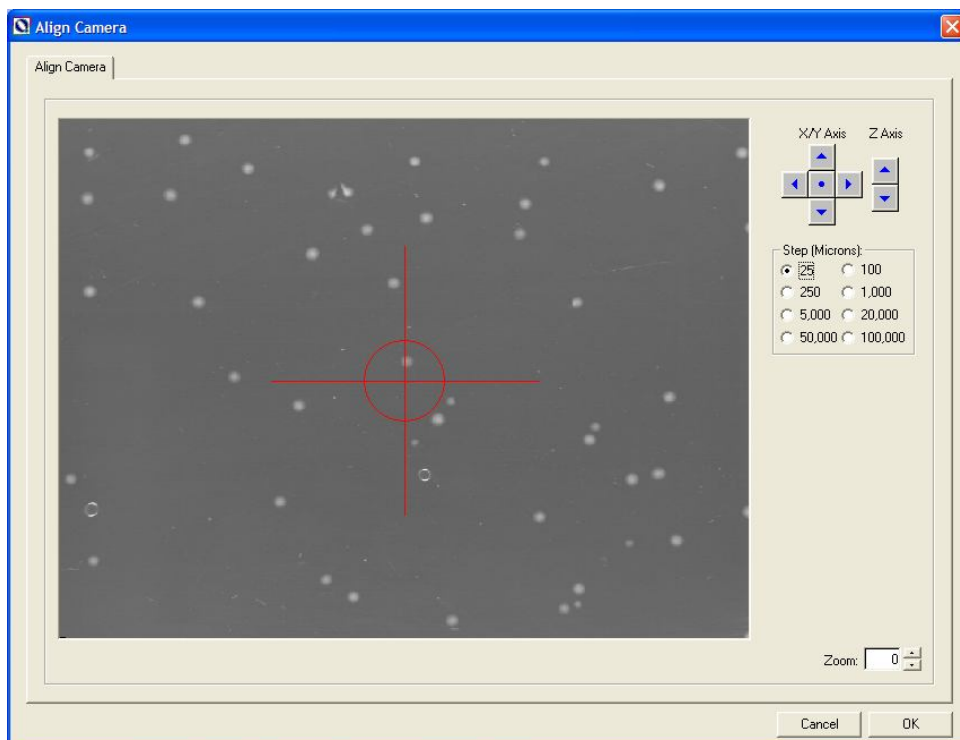


Figure 12:
Camera Alignment

By firing a pin into the agar and then positioning the camera over the resulting "pin-hole" fine adjustments can be made. The camera is represented by the red crosshair symbol. Jog the camera using the jog buttons and use the zoom option to align the cross hair over the centre of the pin-hole. Accuracy is important here as (combined with Datuming the Bioassay Tray) this affects the picking accuracy.

Properties

Displays the **Datum Point Properties** dialog, for the highlighted Datum Point, which in turn allows you to jog the Actuator to the required Datum Point position.

One example of the **Datum Point Properties** dialog is shown here.

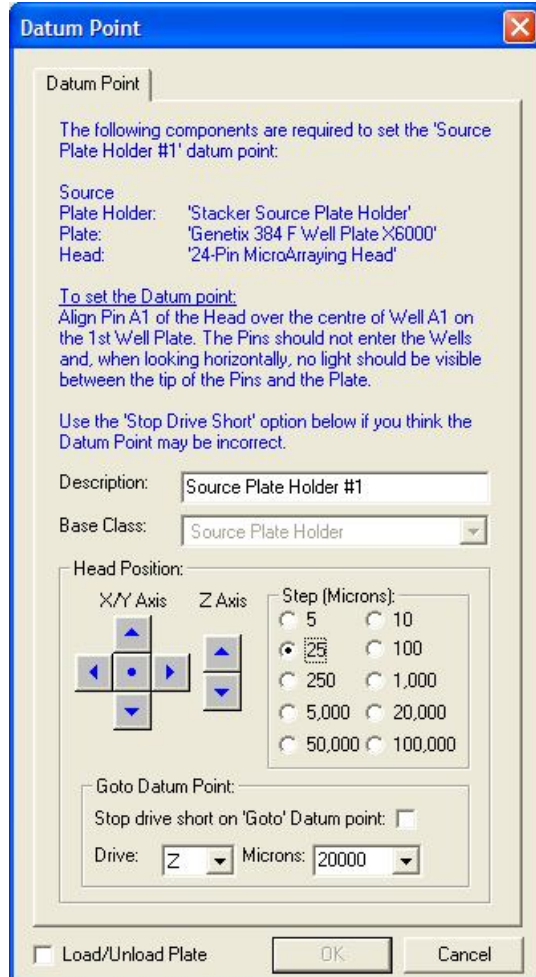


Figure 13:
Set Datum Point dialog

The **Datum Point Properties** dialog is used to accurately define/set certain points on the robot bed, which in turn are used to determine where objects are i.e. bath, dryer, well plates etc. The robot will have been correctly datumed when commissioned by Genetix but may from time-to-time require validating and/or correcting.

When Datuming, you need to use the consumables as displayed in the robot Configuration/Consumables collection i.e. Picking Head, Genetix 384 well plate and robot Destination Plate Holder.

To set a given Datum Point either use the button as described or Jog the Head to the Datum Point using the Jog buttons.

Goto Datum Point

You can go directly to the datum point by clicking the circle (●) in the middle of the jog buttons under Head Position. However, it is always advisable to 'Stop Short' when datuming to prevent any damage to the Head if the Datum Point is incorrect. This is done by clicking the **Stop drive short on 'Goto' Datum Point** and then choosing the drive that you want to stop short on – it is wise to stop short on the Z drive to ensure that the head is not driven too far downwards. Select the distance that you want to stop short (in microns) from the drop down list.

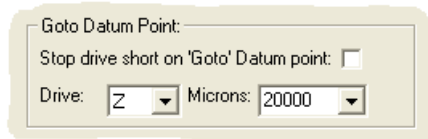


Figure 14:
Set Datum Point - Goto Datum Point

Once the robot has gone to that position you can then use the jog buttons to move closer to the datum points. (Always ensure that you have chosen the correct jog steps).

Head Position

Rather than using the **Goto Datum Point** facility, you can use the jog buttons to set your datum point.

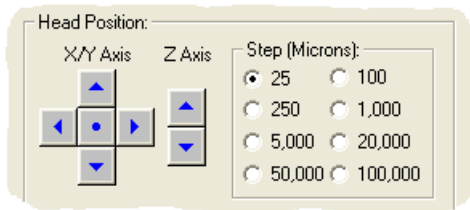


Figure 15:
Set Datum Point - Head Position

The controls under X/Y Axis allow you to move the X and Y axes backwards, forwards, left and right in increments of values set in the Step (Microns) box.

The controls under Z Axis allow you lower and raise the Z axis.

Follow the instructions in the dialog box, paying particular attention to the 'Required Objects' section. Set appropriate step values and use the jog buttons to move the head to each datum point.

If unsure about setting Datum Points, set them high initially and test before setting accurately (and/or test without a Head installed).

Description – Description of the Datum Point – leave as defined by Genetix.

Base Class – Base class of the object from which the Datum Point is derived - leave as defined by Genetix.

Note: When closing the Datum Point Screen please ensure that the position for the selected object e.g. robot Bath is correct before selecting 'OK'. If you haven't altered the Datum Point but have merely opened this screen press 'Cancel'.

OK – Sets the Datum Point using the current X, Y and Z positions.

Cancel – Abandons any changes made and leaves Datum Point setting as it was previously.

It is very important to check that the head is in the correct position before clicking OK. The software will prompt you to do this.

Prior to accepting the configuration the following screen will appear.

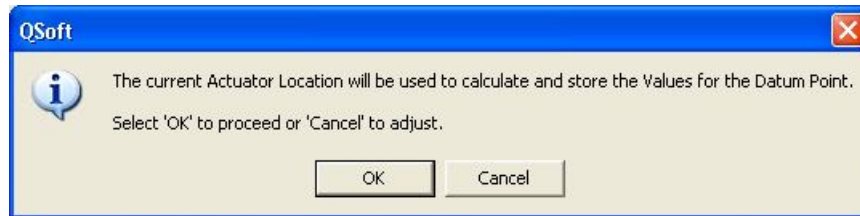


Figure 16:
Store Datum values

Index of Datum Points

Objects that need to be datumed

Bath(s)
Bioassay Tray
Destination Plate holder(s)
Dryer
Filter Block

Defined Objects

Clicking on the **Defined Objects** tab lists all objects currently defined. i.e. bath, dryer, drives, well plates etc.

Import

Allows you to load an object (and all of its properties) that has been exported from another database. When you click the Import button a File ... Open dialog opens to allow you to locate the .xml file.

Properties

Allows you to view the properties of the selected object.

Edit – Allows you to change the current property value.

Log – Displays a list of previous changes made to the selected object.

Export – Will export all properties of the selected object to an XML file, the default name for the XML file will be based on the name of the object whose properties you are exporting, however this name can be changed if required.

Copy – Will allow you to create a new object whose properties are the same as the currently selected object. When you click Copy you will be prompted for a name for the new object.

Refresh

If any object properties are changed, Refresh updates the configuration data to display all currently defined objects.

Add

Allows you to add new objects to the robot configuration. If you select this option you will be presented with the following screen. Only use this option under supervision from Genetix personnel.

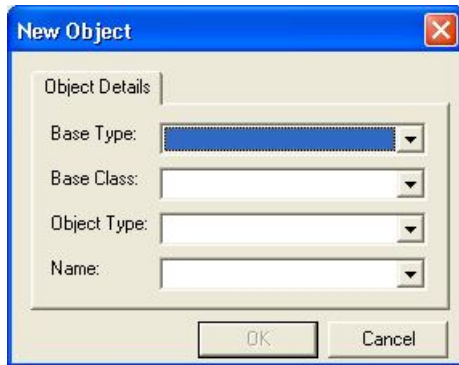


Figure 17:
Add new object

Choose from the drop down lists for Base Type, Base Class and Object Type and either type in a name or select a default name from the list.

Delete

Will delete the highlighted object and all its associated properties from the collection.

Warning: Only use this option under supervision from Genetix personnel as deleting certain objects may render the robot inoperative.

Database

Click the **Database** tab to display the screen shown below. This facility provides a set of utilities for managing/maintaining the QSoft database.



Figure 18:
Robot Configuration – Database

Compact - Compresses the QSoft database and eliminates redundant space. The database can accumulate white space and "grow" which can slow your system down. This operation should be carried out periodically to keep the database at a manageable size.

Back Up – Allows you to create a backup of the database in another location. You will be prompted with a typical Windows "Save As" dialog box to specify a filename and location.

Restore – Allows you to reload a backed up database file, thus restoring a previous configuration.

Datum Log – Displays a table showing all datum settings for at least the previous 21 days. When the table becomes too large, the **Remove** button will delete all entries more than 21 days old.

QSoft Log - Stores a record of changes made to the robot configuration. A check box allows you to purge the log of all entries that are more than 21 days old.

Export I/Os - Updates the configuration file for QSoft IO Manager based on current IO values. This may be used by Genetix service engineers as a diagnostics tool.

Diagnostics and Checking I/O

Diagnostics Screen

The diagnostic button opens the **Diagnostics Screen**, which is used to test the various robot movements depending on the application.

The **Robot Bed Representation** shows a plan view of the robot workbed indicating the positions of all fixed position robot accessories that have been chosen for the routine.

Below is an example of the **Diagnostics Screen** for a QArray 2 using a standard source plate holder.

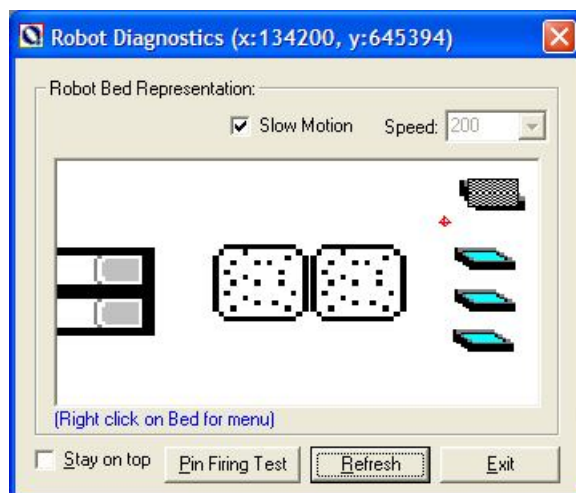


Figure 19:
Representation of QPix2 XT bed

When the robot head is in motion, a small checkered black and white rectangle indicates, in real time, the position of the head with respect to all of these locations.

Routine tests

In order to test a movement or routine, right-click on the Diagnostics screen. A menu will appear which will give you the following options:



Figure 20:
Diagnostics menu

Cancel Menu – closes the window.

Move Actuator to – moves drives to the point at which you clicked on the screen.

Wash Head – washes the head in the selected bath.

Dry Head – dries the head.

Well Plate Stacker – offers the following options.

Get Plate – the specified plate is fed to the plate holder.

Replace Plate – the specified plate is returned to the stack.

QTray Stacker – offers the following options.

- **Get Tray** – the specified tray is fed to the plate holder.
- **Replace Tray** – the specified tray is returned to the stack.
- **Reset Stacker** – any trays on the robot bed are returned and both stacks are reset so that the first trays are ready to be presented.

Read Barcode – If automatic barcoding is licensed, you can elect to read the barcode from either the source or destination container. Enter the number that relates to the position of the object whose barcode you want to read.

Home Drives – homes all three drives.

Other Robot Controls:

Slow Motion - This checkbox places the robot into a slow speed mode, enabling the operator to check out critical movements during the execution of a routine.

Speed – This allows you to set the speed of the drives (only effective in diagnostics).

Stay on Top – Checking this option ensures that the diagnostics screen is not hidden by other open windows.

Pin Firing Test – Clicking on this button allows the robot to test the pins of the picking head by firing them one at a time, from pin number 1 through to pin number 96. This enables you to check for any pin-firing problems before commencing a picking run.

Refresh – Refreshes the objects seen on the diagnostics screen e.g. after changing the robot configuration.

Exit – If the Exit button is clicked, the **Diagnostics** screen is closed and the computer screen will revert back to the **Main Application Setup** screen.

Using the I/O Diagnostics Screen

This facility will allow you to switch various inputs and outputs manually therefore it is only available to privileged users.

To enter the I/O Diagnostics screen click on the I/O's button on the toolbar.

Below is an example of the **Diagnostics Screen**.

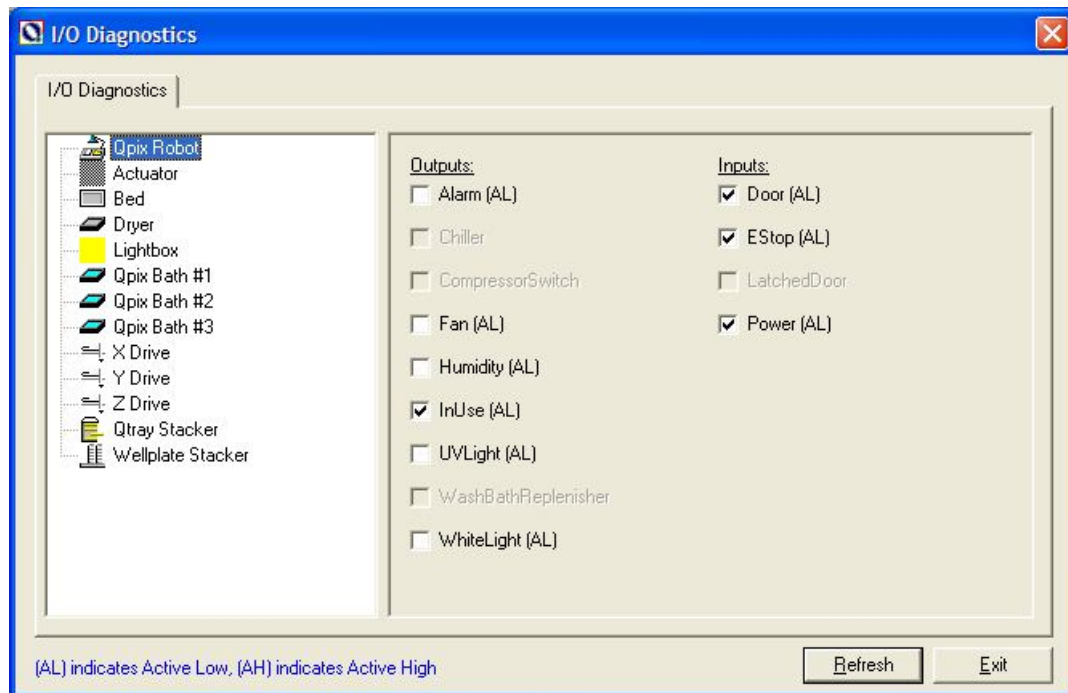


Figure 21:
I/O Diagnostics dialog

This screen represents the state, at any given time, of the Digital Inputs and Outputs of the robot. These are shown to be functioning when there is a ☒ in the box, and off when the box is clear.

Select an object name from the list in the left pane to view the corresponding Inputs and Outputs.

This facility can be used to check the outputs and inputs during the running of a routine.

As well as being used as a monitoring device, this screen also enables you to test various components of the robot. Any input or output feature can be turned on or off manually by placing the mouse pointer over the appropriate box and clicking the left-hand mouse button.

When in diagnostics, if a move is required the drives will enable, the 'Robot Working' light will come on, the move will complete and then the drives will disable and the 'Robot Working' light will go out.

Refresh - Refreshes the objects seen on the diagnostics screen e.g. after changing the robot configuration.

Exit - Clicking the **Exit** button at any time will shut down the I/O Monitor and the computer screen will revert back to the **Main Application Setup** screen.

General Maintenance

Changing the Head

The Z ball-screw drive carries a unique actuator system that accommodates the head. This system allows for easy exchange and set-up of the head.

Remove the head as follows:

- With the robot powered down, move the actuator into an accessible position by hand – be careful not to touch the camera.
- Undo the thumbscrew, which secures the head to the actuator assembly, taking care not to lose the white nylon washer.
- Slide the head out of the actuator.

To fit the head:

- Slide the head into the actuator.
- Tighten the thumbscrew to secure the head.

When handling the heads ensure that they are not dropped, and that none of the pins become bent through being knocked. If any pins do become bent, please replace them immediately.

Damage to pins, especially bending, could produce unreliable results.

Instructions for maintenance of specific heads and pins are given in the relevant application manuals.

Please Note: Each head should be stored in its holder when not in use to minimize risk of damage to pins.

Cleaning the Robot

The bed of the machine should be cleaned before and after each routine that is performed.

- Clean the bed using 80% ethanol or dilute detergent and a lint-free cloth. Organic solvents and abrasive cleaners should not be used, as they will damage the surface of the bed.

Note: Do not pour cleaning solution directly on to the robot bed or other objects, apply using a suitable lint-free cloth.

- UV sterilize by clicking on the UV Light button on the toolbar.



Figure 22:
UV Light button

The following dialog box will open



Figure 23:
UV Light Setup dialog

The sterilizing process is preset to run for 20 minutes but you can adjust the time if required. Ensure that the bed is clear of all objects and that the doors are closed.

Click on the **UV ON** button to continue. The display shows a count-down of time remaining and the **UV ON** button has "toggled" to **UV OFF** which can now be clicked to pause the process if necessary.

Typically this is done at the start and end of each day.

It is also advisable to UV sterilize the head at the start of each day, this can be done by laying it on the robot bed with the pins facing upwards.

When the sterilizing process is complete, click the Done button.

- Soak the wash bath and brush in 1% sodium hypochlorite for 30 minutes, rinse with distilled water then allow to drain.

Regular Maintenance

Daily

- Ensure that the robot interior is free from dirt and dust (see Cleaning The Robot - above). In particular, check the surface of the x-axis drag-chain support bracket, dust and debris accumulated here can be swept onto the robot bed during operation.
- Remove, clean and sterilize wash bath(s) and brushes (see above).
- Ensure that nebulizer replenishment tank is full and contains no debris.
- Check the air regulator for signs of moisture. If necessary, push the drain upwards to force moisture out.

Weekly

- Dismantle picking and gridding heads completely and thoroughly clean all component parts (detailed instructions for dismantling the heads are given in individual application manuals).
- Check operation of interlock switch.
- Check operation of emergency stop.
- Check silicon tubing for signs of wear. If tubing splits or perishes, this could cause damage to the pump. Replace tubing as necessary.
- Check robot door for damage / crazing and evaluate for UV emissions if required.

Annually

- Maintenance by manufacturer – (only to be carried out by Genetix approved personnel).

As Required

- Replace UV tube (approximately every 3 months).
- If the robot is used in particularly dusty conditions, the air filter should be checked and may need to be replaced more frequently than recommended.

General Precautions

- Disposal of waste.
All wastes, e.g. ethanol, must be disposed of according to local regulation. Ethanol is flammable and should be handled accordingly.
- Do not use in explosive environments.
- For safety reasons the door interlock should never be interfered with or overridden. If the doors are opened at any stage, a warning message will be displayed. You have the option to close the door and continue the run or to abort the run.

Troubleshooting

Common Problems

Problem	Possible Solutions
Machine won't turn on	Check that main power switch is turned on, the start button is pressed and the emergency stop is pulled out
Computer won't start	Check the power switch on the PC
One or more of the axes won't move	Check that the main power switch is turned on and the start button is pressed
Overhead or table light won't turn on	Check that the bulbs are not burned out
UV light won't turn on	Make sure that all doors are tightly closed
Camera won't image	Check that the lens cover has been taken off, make sure aperture is open on lens
Calibration fails	Colonies are too dense and/or too small, try calibrating on another plate.
Picking alignment incorrect	Align the picking pin, check for any bent pins on picking head
Imaging too bright or too dark	Adjust the aperture of the camera to the proper position
Picking Blue colonies	Adjust the threshold and Blue threshold
Double picking on edges of image frames	Set the Check Overlaps at a higher value
Not enough colonies being picked	Check size, roundness, axis ratio, and threshold parameters, lower the Check Overlaps value
Erratic picking across a plate	Check that air pressure is at 80 psi, check for any sticky pins, clean head regularly
Crashes when inoculating destination well plates	Make sure plates are positioned the right way round in holders with lids off
Picking pins bending on edge of bioassay tray	Check agar volume setting, bioassay tray positioning, tray holder positioning in the bed
Picking pins going down too far/not far enough	Check that the agar volume setting on the main screen is correct, adjust the configuration Adjust Picking height
Plate not loading smoothly into the return cassette	Check locking device at rear of cassette – levers should be in locked (up) position
Plate not exiting feed cassette correctly	Check that plates are stacked correctly Ensure that none of the plates or lids are damaged
QTrays not de-lidding correctly (MegaPix only)	Check that QTray or lid is not damaged or cracked
"Door Open" dialog is displayed	Check front lifting door is closed Check both doors on QTray stacker are closed (MegaPix) Check that compressor is on
Tray or tray lid jammed during operation (MegaPix only)	Refer to the stacker recovery procedure described in Appendix A
Well plate or plate lid jammed during operation	Refer to the stacker recovery procedure described in Appendix A

Recommended Spare Parts

Spare Parts List for QPix2 XT

Code	Description
X4300	Picking Head 96 Pin
X4370	Picking Pins - Standard E. coli - 0.6mm tip
X4371	Picking Pin - 1.00mm
X4372	Picking Pin Yeast - 1.6mm
X4373	Picking Pin - Barbed 1.00mm
X4374	Picking Pin - Honey Dippers
X4390	Picking Springs
X4460	Destination Plate Holder
X4352	UV Tubes
X4430	Light Box Fluorescent Tubes
X4470	Wash Bath
X9050	Replenishment Bath
X4475	Wash Brush
X4500	QPix2 XT Compressor 240V



Glossary of Terms

Array

Nylon filter or slide on which the clones are immobilized or array of DNA/protein spots on a glass slide.

Arrayed

Distribution of colonies or samples into known positions from 96 or 384 well plates.

Base Class

Blueprint for the properties of an object.

Bioassay Tray (QTray)

22x22 cm clear plastic tray from which colonies/phage are picked.

Bioassay Tray Holder

Perspex holder fitted to the robot bed for holding two Bioassay trays in place whilst carrying out a Picking routine.

Block

A pattern of clones or spots immobilized within an array produced by one pin.

Blue Imaging Light/Blue LED

Excitation light for fluorescent gels.

Blue/White

Blue White selection protocol for visualization of colonies expressing β -galactosidase.

CCD Camera

Charge Coupled Device Camera. A cooled digital camera for capturing high-resolution images with a wide dynamic range.

Clone

A particular DNA moiety contained within a DNA vector and propagated in a host cell.

Compressing

Converting 4 x 96 well plates into 1 x 384 well plate etc.

Custom Property

A custom property is a value that you can apply to samples at a given location in order to use later in the Data Tracking search facility.

Datum Point

A series of X, Y, Z co-ordinates that define a set position on the Robot bed.

Destination Plate Holders

Holders for microplates located on the bed of the robot. The number of Plate Holders available depends on which robot is being used.

DMF

Dimethyl formamide.

Excision

A picking process for extracting spots from a protein gel that uses a hollow pin and vacuum pressure to excise the protein.

Excision Pins

The precision tools that cut the gel plugs from the gel. Available in various sizes.

Expanding

Converting 1 x 384 well plate into 4 x 96 well plates etc.

Field

An array is divided into fields. The field is the area covered by the head.

Filter Block

Solid blocks onto which gridding membranes are placed (15 per QBot, 2 per QPix).

Gel Holder

Cassette that supports gels during the Imaging and Excision processes.

GFP

Green Fluorescent Protein. Used to monitor subcellular protein localization, analyze differential gene expression. Protein interactions and cell transfection efficiency.

Grabber

Set of jaws on QBot actuator used to pick up microplates.

Gridding head

Head used for gridding and replicating. Available in 96 pin or 384 pin formats, either sprung or gravity.

Guide Spot

A reference spot created by the user, in order to make grids (arrays) easier to read.

Hybridisation intensity

(as judged by pixel intensity) is a measure of gene activity.

I/O

Inputs / Outputs.

IPTG

Isopropyl-thio- β -D-galactoside.

LB

Luria-Bertani Medium.

LIMS

Laboratory Information Management System.

MADGE

Microplate Array Diagonal Gel Electrophoresis.

Marker Spot

A reference spot created by the user, in order to make grids (arrays) easier to read.

Multi-spot pin

Microarray pin which is loaded with a volume of sample which is then dispensed in aliquots.

Phage

Bacteriophage.

Picking Tray

See Bioassay Tray Holder.

Plate Hotels

Holders for microplates located at the front of the QBot available in 2 formats. The standard Genetix hotels hold 36 plates each, and non-Genetix hold 24 plates each.

Probe

A labeled DNA or RNA used to hybridize to an array.

Process (Data Tracking)

A routine performed on the data or an import from a file in QSoft Library Manager format.

QSoft Library Manager

This is the predecessor of QSoft Data Tracking.

QSoft.DLL

ActiveX software component housing all the functionality of robot software.

Rearranging

Redistribution of selected colonies into new plates performed with picking head.

Receptacle

Container used in Data Tracking - such as well plate, bioassay tray, slide or filter.

Replicating

To copy, compress or expand 96 or 384 well plates.

Script

Listing of all moves needed to complete a routine.

SDS

Sodium Dodecyl Sulphate.

Spot

Corresponds to a visual hybridization imprint of a clone with a probe.

SSC

Sodium Chloride/Sodium Citrate buffer.



Sub-Grid

(See Block)

White Imaging Light

Illumination for color-stained gels.

X Drive

Axis running from back to front of the QBot and QArray Mini bed or right to left on any other bench-top robot.

XML

Extensible Markup Language. A simple text format derived from SGML Originally designed to meet the challenges of large-scale electronic publishing, XML is also used in the exchange of a wide variety of data on the Web.

Y Drive

Axis running from left to right across the QBot and QArray Mini bed or back to front on a bench-top robot.

Y2H

Yeast 2-Hybrid. Screening of 'prey' proteins encoded by cDNA libraries for interaction with a particular 'bait' protein.

Z Drive

Axis running vertically on the Robot bed.

Appendix A

Stacker Recovery Operation

In the event that plates, trays, Petri dishes or lids get jammed Genetix has implemented recovery procedures that will isolate the stacker(s) and allow you to resolve the problem without interrupting the software routine.

If a plate or tray does not reach the correct position on the bed, the appropriate sensors will not be triggered and the software will eventually "time out" and will respond with an error message.

In many cases it is possible to recover the situation using the I/O controller within the application (this will be generated after the time-out message). The screen will vary according to which robot you are using.

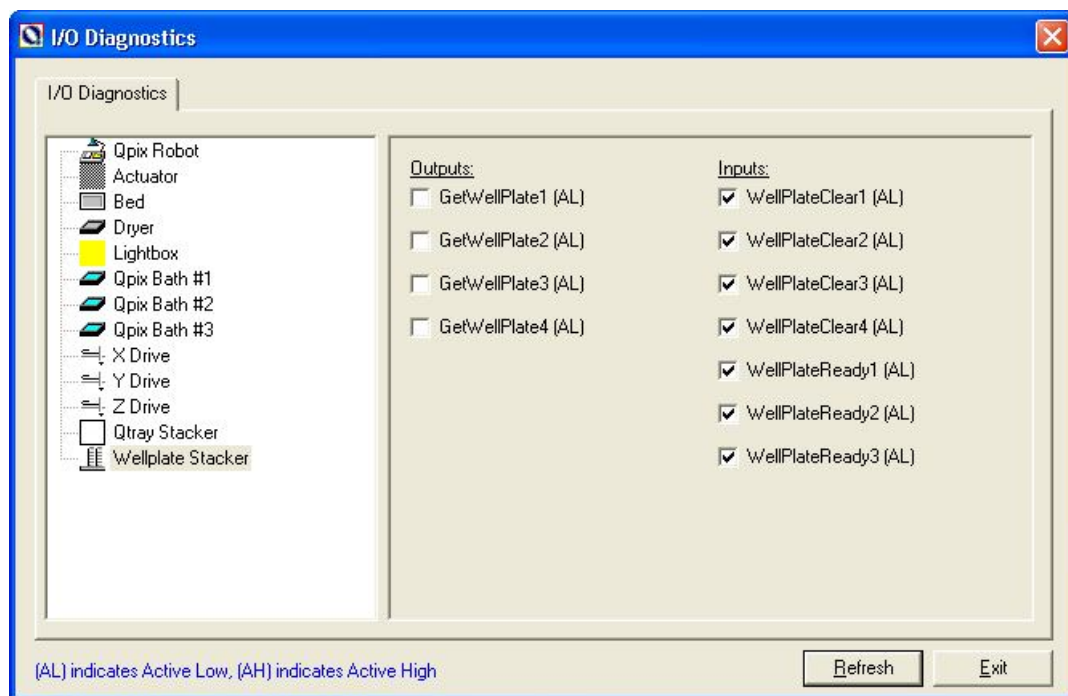


Figure 24:
I/O Diagnostics dialog

Click the stacker name in the left-hand pane of the I/O Diagnostics window. The Inputs and Outputs for that object are displayed in the right-hand pane. You can control the movement of each lane of a stacker by checking/unchecking the boxes. For example OPGetWellPlate1 controls lane 1 of a well plate stacker, OPGetWellPlate2 will allow you to move lane 2 and so on.

For more information on using the I/O controller, see the section headed "Diagnostics and I/O".

If a plate or tray is jammed in such a way that the I/O controller cannot move the mechanisms then you need to recover the situation manually.

Well Plate Stacker

If an error occurs feeding a plate on to the bed, collecting a lid or returning a plate to the stacker, two things will happen.

- After approx 20 seconds, the software will time out.
- An error message similar to this is displayed.

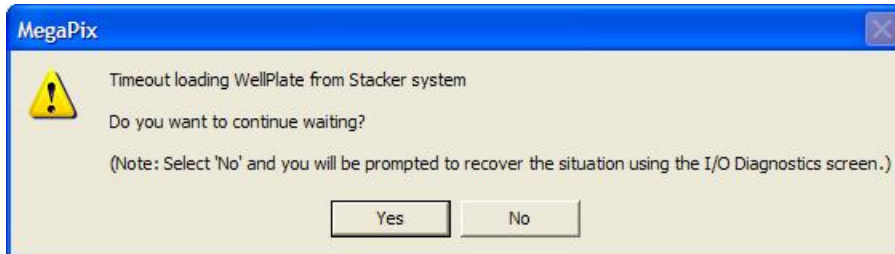


Figure 25:
Well plate timeout message

Important - do not respond to this message yet

Scenario 1

The plate has been fed onto the lane without lid being removed properly.

This situation can be resolved in the following way:

- Remove the plate lid.
- Insert the lid into the ramp (make sure the orientation is correct).
- Ensure that the lid is resting correctly on the ramp.
- Click No in response to the "Continue waiting " message.

Scenario 2

The plate and/or lid are stuck tightly or at an angle which doesn't allow easy removal.

This situation can be resolved in the following way:

- Press and hold the recovery button that corresponds with the jammed stack (the recovery buttons are the red buttons located on the end of each well plate stacker unit).
- If the plate is not returned to the destination stack correctly, the recovery button will flash in warning. Remove the stacks and manually remove the plate and lid.
- Check the bed, lanes and tracks for fragments of broken plate or lid.
- Now respond to the "Continue waiting" message by clicking No. The software will continue processing from where it left off.

QTray (Rear) Stacker (MegaPix only)

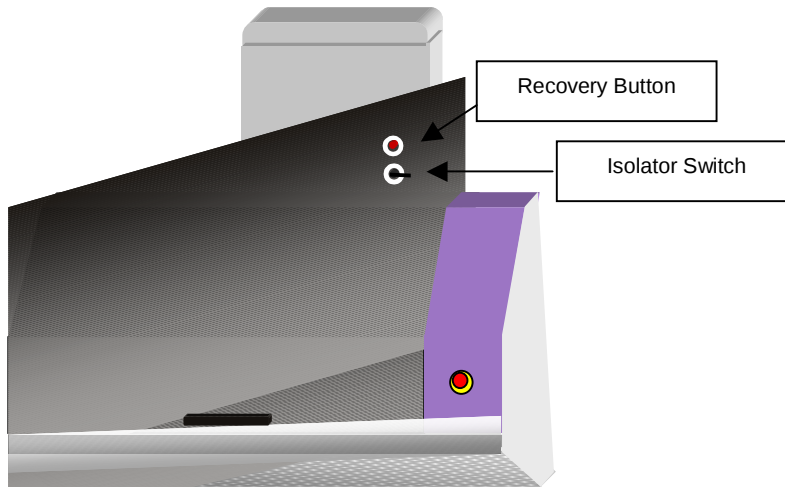


Figure 26:
QTray Stacker switches

The QTray recovery procedure is a 3-stage process.

Stage 1

If an error occurs feeding trays or Petri dishes on to the bed, four things will happen:-

- After approx 20 seconds, the software will time out.
- An error message similar to this is displayed.

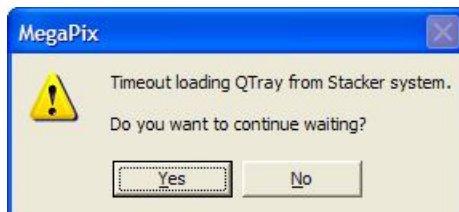


Figure 27:
QTray timeout message

Important: Do not respond to this message yet

- The stacker unit goes into a recovery condition (drive motors power down) but the robot still has power.
- The red lamp on the recovery button will flash **three** times, pause, and then flash again **three** times. This will continue until you respond.

Respond as follows:-

Clear the jam from the machine by removing any obstacles e.g. trays, Petri dishes and lids. To do this, push the plate/Petri dish holder away from the bed or make sure that there is free access back to the stacker.

Check the bed for fragments of broken trays or lids.

Press recovery button **once** only.

The stacker will withdraw the tray feeder arms from the bed of the machine back into the stacker unit.

Stage 2

The red lamp will now flash **twice**, pause, flash **twice** again and continue until you respond.

Press the recovery button **once**.

The stack will reset to home position (bottom).

Stage 3

The red lamp will now flash **once**, pause, flash **once** again and continue until you respond.

Press the recovery button once more.

The stacker will now travel to last known position and feed a tray (from the same position as the jammed tray) into machine.

Now respond to the "Continue waiting" message by clicking **No**. The Software will continue processing from where it left off.

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