

## QMax Workstation for iQue® Enablement

Extend Run Time up to 48 Hours



### Technical Note

#### Scope

This technical note introduces the QMax system components, setup considerations, routine maintenance practices, and highlights performance data.

### Abstract

High consumption of fluids and the accumulation of waste is a major concern for high throughput flow cytometry. While the unique fluidic system of the iQue® technology dramatically reduces the overall consumption of sheath fluid compared to traditional methods, prolonged assay times may still require user intervention thus increasing the risk of delays, reagent loss, and exposure to waste fluids. Longer uninterrupted run-time can be achieved by pairing the iQue® Platform with the iQue® QMax workstation, where the QMax would seamlessly refill the sheath fluid container while managing waste levels. This technical note introduces the QMax system components, setup considerations, routine maintenance practices, and highlights performance data.

# Introduction

The iQue® High-Throughput Screening (HTS) by Cytometry Platform incorporates integrated fluidics that support routine high-throughput screening workflows. For applications requiring extended unattended operation, continuous plate processing, or overnight runs, additional fluid-management capacity may be beneficial. The iQue® QMax Workstation is designed to automatically replenish sheath fluid and remove waste, enabling longer uninterrupted operation and reducing the need for operator intervention. Additionally, the QMax Workstation makes transportation of large volumes across the lab safe and easy and minimizes risk of contact to waste during disposal.

## ▪ **Extended Unattended Operation:**

The QMax system supports continuous instrument use for up to 48 hours dependent on the protocol used by automatically managing fluidics, including seamless sheath fluid replenishment and waste removal, thereby eliminating the need for frequent manual intervention.

## ▪ **Support for Automated Plate Acquisition:**

The iQue® Platform is designed for simplified connection to automated plate loading technology, the QMax Workstation supports the fluid maintenance required for these longer plate runs. This prevents pauses mid-run and maintains consistent high throughput plate analysis.

## ▪ **Reduced Downtime:**

Automated fluid monitoring and ability to empty the waste while the system is running without interrupting data acquisition termed hot-swappable feature. Help minimize unplanned interruptions associated with low sheath fluid levels or full waste containers, reducing downtime and improving workflow continuity.

## ▪ **Simplified, Safer Maintenance:**

Routine procedures such as emptying the waste are made easier with the use of the drainage pistol, removing the need to lift heavy bottles and reducing manual exposure to biohazardous waste.

For workflows involving large compound libraries, antibody discovery campaigns, or very high plate numbers, QMax-equipped systems support a closed assay process without operator intervention to reduce operator oversight and improve laboratory productivity.

# The QMax Workstation

The device consists of a controller unit and a trolley.

The **Trolley** is used to house and transport the carboys and includes an integrated waste drainage system. There are two carboys one for Sheath and one for Waste which sit on the trolley (Figure1).

1. Houses the two 20 L carboys, Sheath reservoir and matched Waste container. Through integration with iQue Forecyt® software the automatic refill and emptying of the onboard fluidic bottles is supported.
2. Waste levels are monitored in iQue Forecyt®, when full, it is easy to disconnect the carboy via the quick-disconnect valves, empty and if needed decontaminate. Then securely reconnect so automated monitoring can continue.
3. Fitted with a drainage pump to facilitate drainage of the waste to reduce the manual handling burden. Includes a hot-swap feature to drain the waste bottle without stopping the run.

The **Controller Unit** which sits under the bottle station is designed to:

1. Monitor fill levels in the Bottle Station bottles and carboys
2. Convey liquids between the Bottle Station bottles and the carboys via a fluidics harness which links the bottles, controller, and trolley-mounted carboys.
3. On the Controller, a status light of different intensities indicates operating state and warnings.

All connections are designed for quick and easy identification using color coded cables.

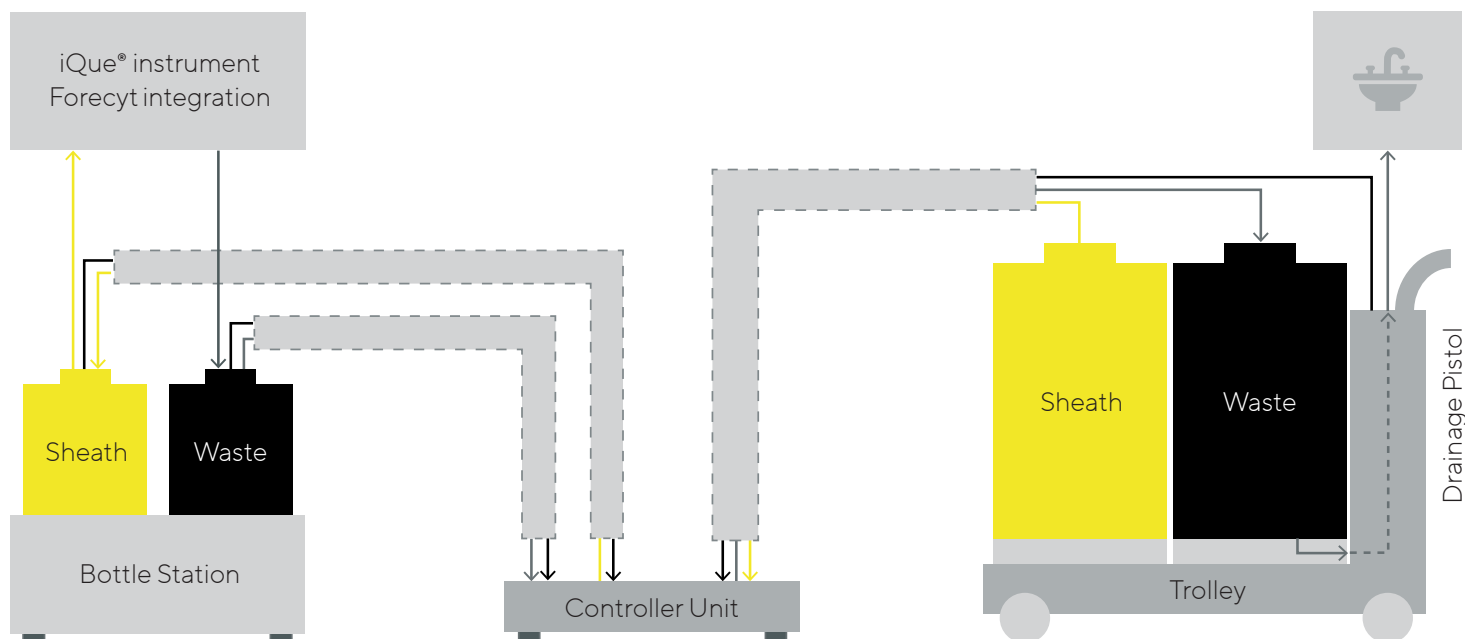


Figure 1: Schematic of iQue® QMax Workstation layout

## Tips for System Use

### Integration with iQue Forecyt®

To enable full QMax connectivity in Forecyt ensure that “enable QMax” is ticked in the iQue® Options window assess-able from the Device tab. This will enable the automatic detection of sheath and waste levels in the carboys and display contents on the liquid levels tab (Figure 2). If you hover over the image, the estimated volume is shown.

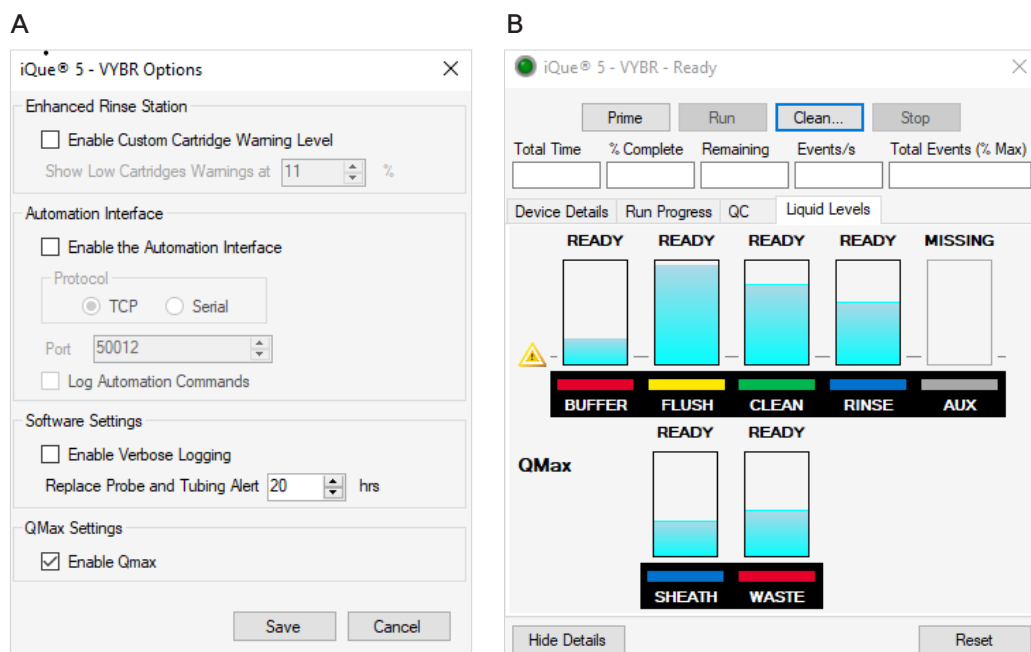


Figure 2: Integration with Forecyt (A) fully enable QMax within Forecyt, (B) visual liquid level assessment in Forecyt. Warning triangle indicates the 11% level for cartridges.

# Case Study to Investigate Plate Throughput

## Sheath Bottle Refill

Prepare diluted sheath from concentrate as described on the bottle using pure filtered water to avoid flow cell clogs. Ensure the solution is thoroughly mixed.

## Waste Bottle Emptying

The 20 L waste carboy becomes very heavy when full. Use the trolley to move the waste to the drainage point to avoid lifting. The trolley comes fitted with long fluidics harness (6 m) and power cable (5 m), for sink or drainage within this range there is no need to disconnect the bottles. If further away, carefully disconnect all fluid lines using the quick connectors, then use the trolley to move waste to the sink. To use the drainage pistol it needs power so it will need to be plug in within range of the sink. Empty the waste using the drainage pistol following institutional/biosafety guidelines. Afterward, add a small amount of concentrated bleach to the empty container to prevent biological buildup and reconnect the lines, ensuring sensors are firmly in place.

## Tubing and Cabling

Sheath (Blue) and waste (Red) lines are equipped with quick-connect fittings on both the trolley and the fluidic station, allowing easy connection to the respective sheath and waste carboys/bottles.

## Installation Requirements

The controller unit sits on the laboratory bench under the bottle station, on an ideally stable, even surface with no vibration. The trolley is sited on the floor, e.g., under a laboratory bench.

## Maintenance Schedule

Recommended to include in routine daily check with a scheduled fluidics service. Recommended to replace the sheath carboy filter every 2 months and carry out full fluidics maintenance every 176 hours of instrument runtime.

To demonstrate the features of the iQue® QMax Workstation, a mock screening scenario was performed using an iQue® 5 HTS Platform connected to an iQue® QMax Workstation. Jurkat cells were seeded at a density of 20,000 cells in 20 µl per well in a 384 well V bottom plate in complete medium to evaluate high throughput plate performance. Configuration of the protocol is shown in the screen shot (Figure 3):

1. iQue Forecyt® software was launched and the protocol defined.
2. Fluidics were prepared by emptying the waste carboy, filling the sheath carboy to 20 L, and verifying all liquid levels on the instrument deck.
3. Acquisition parameters were set to mimic a screening scenario designed to ensure smooth sample acquisition.
  1. Sip time 2.0 s with an additional 0.5 s extension
  2. Automatic prime every 60 s
  3. Mid plate cleaning after every 4 wells
  4. Plate shaking (2000 rpm) included after every 12 wells for 4 s
  5. Post plate cleaning step was disabled.
4. The plate run was initiated, resulting in a total run time of approximately 44 minutes per plate under the specified conditions.

After acquisition of eight 384 well plates, approximately 4 L of sheath fluid were used and ~4.4 L of waste were generated. Extrapolating from these values using this protocol set up, the system would accommodate continuous operation of approximately 32 – 35 plates within 24 hours without interruption, corresponding to an estimated 17 – 18 L of sheath usage and 18 – 19 L of waste production over that period. Without the QMax installed, using this protocol, the bottle station waste and sheath would need emptying and replacing every 4 plates. For a run of 32 – 35 plates this would result in 8 – 9 interruptions to replace solutions.

**Figure 3:** Protocol setting for mock screening acquisition

## Summary

Overall, the performance of the iQue® HTS Platform in combination with the iQue® QMax Workstation demonstrates markedly increased laboratory productivity and extended hands off runtimes to deliver actionable results faster. Extension of run times is depended on protocol settings but can be up to five-fold to deliver 48 hours of continuous operation.

## Run Warnings and Errors

### ▪ Waste Carboy High

Indicates that the waste container is nearly full (status light flashing with decreasing intensity) and requires emptying.

### ▪ Sheath Carboy Low

Indicates that the sheath solution is nearly empty (status light flashing with increasing intensity), and the sheath carboy must be refilled.

### ▪ Waste Carboy Full

The waste reservoir has reached capacity, resulting in termination of waste fluid conveyance by the controller unit. The status indicator flashes at constant intensity; Empty the waste carboy to resolve the error and resume normal operation. The user will still have some capacity in the bottle station waste bottle to support plate throughput whilst the carboy is emptied.

### ▪ Sheath Carboy Empty

The sheath reservoir is depleted, leading to cessation of sheath solution conveyance by the controller unit. The status indicator flashes at constant intensity; Refill the sheath carboy to clear the error and restore function. The user will still have fluid in the bottle station sheath bottle to support plate throughput whilst the carboy is refilled.

### ▪ Waste Pressure Error

Overpressure is detected in the waste fluidics line (e.g., due to blocked or kinked tubing), causing interruption of waste fluid conveyance and a constant intensity flashing status indicator. Inspect the waste tubing for occlusion or kinks and rectify as necessary to re-establish normal pressure and operation.

- In case of an emergency, the trolley is fitted with emergency stop button.

# iQue® QMax Workstation Systems Specifications

| Item                                          | Details                                               |
|-----------------------------------------------|-------------------------------------------------------|
| Sheath carboy capacity                        | 20 litres                                             |
| Waste carboy capacity                         | 20 litres                                             |
| Trolley dimensions<br>(L×W×H, weight)         | 67.5 cm × 55.5 cm × 105 cm<br>26 kg (without carboys) |
| Controller unit dimensions<br>(L×W×H, weight) | 27.2 cm × 28.2 cm × 6.6 cm<br>2.43 kg                 |
| Fluid level monitoring                        | Forecyt® integration and<br>visual display            |
| Trolley power cable length                    | 500 cm                                                |
| Trolley bundled fluidics harness              | 600 cm                                                |
| Waste handling                                | Drainage pistol                                       |
| Instrument compatibility                      | iQue® 5, iQue® Screener, Plus, 3                      |
| iQue® QMax Workstation                        | BA-97146                                              |
| QMax Refill Module Sheath<br>Carboy Filter    | #91311                                                |
| Sheath Additive Concentrate<br>(100 mL)       | #91310                                                |

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