

My Little Bioreactor

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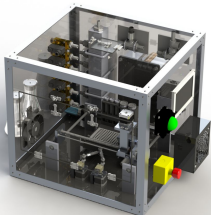
Abstract

My Little Bioreactor is a semi-autonomous microbioreactor that prioritizes simplicity and synergy. The bioreactor is composed of eight primary systems that have been consolidated to reduce the number of components and potential failure modes. A single multiport selector valve is used to dispense culture fluids, gaseous commodities, and disinfection compounds to well plates and conical tubes. The valve is mounted to the XYZ gantry system, which also holds the optical density and fluorescent intensity measurement system. The optical sensing system is customizable and capable of OD600 measurements in conical tubes and well plates, as well as fluorescent intensity measurements of over 20 different fluorophores. The cell cultures can be temperature-controlled from 5-70 C using a conduction heat-exchanger, which circulates water below the well plate. Below the thermal plate is the shaker plate, which can shake the cultures in adjustable-diameter orbital, double orbital, and linear patterns. This is achieved using a system of driven kinematic linkages that can move the shaker plate on a dual-axis slide. Using one-way cross-slit silicon valves as lids for the conical tubes, gases can be injected to create a unique atmosphere while containing all the biological materials

Functionality

My Little Bioreactor is centered on creating a semi-autonomous system where cellular studies and biological growth processes are performed. Our design achieves this through the optimization of eight subsystems. The microbioreactor enclosure creates a fully insulated environment, while also providing structural support for the other subsystems. The translational subsystem's lead-screw driven gantry system allows for OD/FI sensing, fluid handling, gas, and waste management subsystems to be displaced in the XYZ axes. The thermal control subsystem's custom plate creates a conduction to liquid convection process to uniformly control the temperature of each separate culture. LED strips and ambient light sensors in the OD/FI system record necessary measurements for each cell culture. The dynamic subsystem consists of adjustable kinematic linkages allowing for variable shaking amplitudes and patterns for the well plate cell cultures. The fluid handling syringe pump and selector valve provides the flexibility to dispense any liquid, as well as to extract liquid/waste from the different well plate slots in combination with the waste management subsystem. Gas management's solenoid valves allow for isolated injection of 6 different gases, along with fitted test tube silicone valves to maintain independent internal environment conditions.

Full Assembly



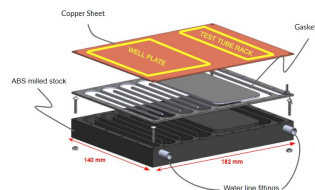
Optical Sensing

Using multiple chromatic filters, LEDs and Ambient Light Sensors, this customizable OD/FI tool is capable of performing up to 4 different FI measurements in one experiment. Sensors measure each well and conical tube independently. Custom-made tube rack allows for accurate measurements.



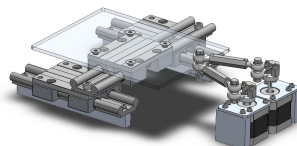
Thermal Control

Refrigeration pump and electric heating element are used to change circulating water temperature, which will result in conduction heat transfer to the culture samples to achieve the desired setpoint temperature using our custom heat exchanger.



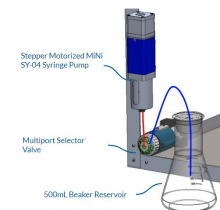
Dynamic Control

Using a system of driven kinematic linkages, the dynamic control system can move the shaker plate in adjustable-diameter orbital, double orbital, and linear patterns.



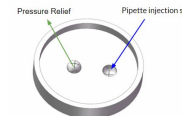
Fluid Handling/Waste

Single reusable and retractable pipette system connected to a multiport selector valve and syringe pump is used carry out fluid dispensing and extracting operations. System will have capabilities of using up to 4 cell culturing media along with the necessary sanitation liquids to prevent any contamination. The fluid handling system is displaced across the bioreactor by being mounted on a tool head on a lead-screw driven gantry system.



Gas Management

Independently controlled solenoid valves prevent reactive gaseous mixtures, while custom test tube valves maintain internal environment.



Prototype cost : \$7681.55

Customer Needs Tracing Map

