NEXT ADVANCE
Innovative Lab Products for the Life Sciences

RoboRocker™

The Ultimate Rocker for Advanced MPS Applications

Programmable, incubator-safe rocker ideal for organoid and cell culture systems

Abstract

The RoboRocker™ is a fully programmable rocking instrument engineered specifically for organoid culture, cell culture, and microfluidic chip-based perfusion systems. Building on more than a decade of proven reliability and long life from Next Advance's Infinity Rocker product line, the RoboRocker introduces multi-axis motion control, programmable pauses, customizable platforms, and precision motion profiles.

These capabilities enable researchers to create highly controlled, physiologically relevant environments that better replicate *in vivo* conditions. Designed for both standard laboratory workflows and cutting-edge research applications, the RoboRocker delivers flexibility, durability, and seamless integration with modern experimental systems.

Figure 1. A RoboRocker operating inside an incubator.

Introduction

Cell cultures and microphysiological systems (MPS) are transforming biological research by enabling more accurate modeling of human tissues and organ-level function. These systems often rely on dynamic fluid flow to mimic physiological processes such as nutrient or drug delivery, waste removal, and stimulation.

Two typical methods to control the flow of culture media in these systems are pumps and gravity. Unlike pump-based setups, gravity-driven flow eliminates the tedious task of purging air bubbles from tubing and connections, and it supports large numbers of parallel channels without added complexity. In contrast, pump-based systems require a dedicated pressure or displacement source for every individual culture line, e.g. separate syringe or peristaltic pump channel, which imposes significant scalability limits when expanding to large arrays of culture chambers.

Gravity-driven flow is typically controlled by tilting the culture plates using a laboratory rocker. However, traditional rocking platforms have several major drawbacks. They lack the precision, programmability, and environmental compatibility required for advanced MPS applications. For example, organ-on-a-chip devices are typically used in CO_2 incubators and can demand tightly controlled flow dynamics, including defined shear stress, cellular and organ cross-talk, directional perfusion, and/or timing of media exposure.

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The RoboRocker product line was developed to address these limitations by providing:

- Incubator-safe operation for long-term studies
- Highly programmable motion, including pause periods at desired tilt angles
- Independent forward and reverse tilt control for asymmetric flow
- Two independent axes of tilt for multi-directional movement
- Customizable platforms for chip formats, load capacity, and integrated instrumentation
- And other features for specialized applications.

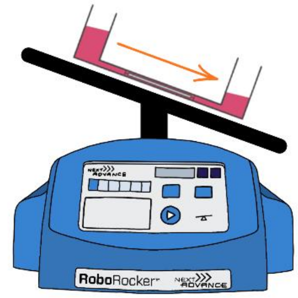

Figure 2. Gravity-driven flow enables precise perfusion in dozens or hundreds of organoid culture channels in parallel.

The RoboRocker transforms rocking-based culture from a simple mixing method into a powerful tool for simulating physiological environments.

Incubator-Safe Design

The RoboRocker is engineered for continuous operation inside humid, CO_2-rich incubator environments. Unlike most conventional laboratory rockers, the RoboRocker is designed to withstand corrosive conditions while maintaining long-term performance and stability.

Next Advance has produced incubator-safe rockers for over a decade, with instruments operating continuously in laboratories worldwide. This proven design ensures reliability for long-term experiments, including organoid maturation and exposure studies.

Proven Reliability

Reliability is critical for experiments that run over days or weeks. Most laboratory rockers suffer from short lifespans, typically due to motors or belts wearing out. To provide rockers that will not fail in the middle of your culture study, Next Advance introduced a line of rockers in 2010 that use brushless motors and no belts. These rockers have demonstrated exceptional durability, with most units operating maintenance-free for over 10 years. The RoboRocker builds on this legacy, providing dependable performance for long-term organoid culture, continuous perfusion in microchip systems, and in automated and unattended workflows.

Programmable Pause at Any Angle

Most conventional rockers are limited to a continuous movement and cannot pause at a desired position. The RoboRocker introduces controlled pausing at any tilt angle for a specified duration. This function enables regulated, enhanced sustained perfusion through 3D organoids, and regulated exposure to drugs or stimuli within tissue cultures.

This capability is particularly valuable in organoid systems and microfluidic platforms, where extended perfusion is required for proper nutrient exchange and complete waste removal. Without the pause, traditional rockers can only recirculate a portion of the medium. Over time, that portion will become more depleted of nutrients and have a greater accumulation of waste products. By holding precise angles for controlled durations, the RoboRocker maintains accurate flow rates that support targeted nutrient delivery and efficient waste clearance. This results in more reliable culture conditions and enables experimental designs that require defined exposure periods.

Figure 3. The RoboRocker tilts to the desired angle (left), then holds that angle for a defined pause period (center), enabling full perfusion of fresh medium and complete waste removal. After the pause, it advances to the next angle (right). In contrast, traditional rockers only allow short periods of perfusion and recirculate the same portion of the medium, leading to nutrient depletion and waste buildup.

Steep Tilt Angles of 45° and More

Traditionally, laboratory rockers are limited to a maximum tilt angle of about 15 degrees. For mixing liquids this is usually satisfactory. However, for shear flow, this is rarely sufficient. Steep tilt angles allow for rapid fluid displacement and increased shear forces. This is particularly useful for culturing and studying shear-sensitive cell types or simulating physiological stress conditions. The steep-tilt RoboRocker can tilt to 45 degrees, while other models can be customized with even steeper angles to further expand the range of achievable shear flow.

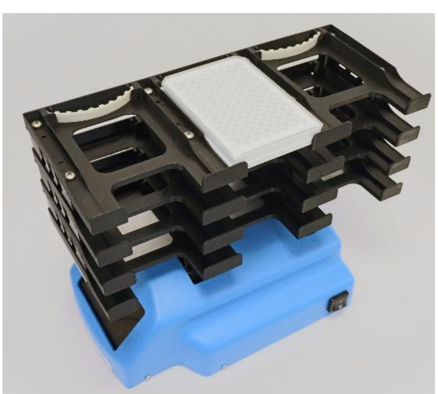

Figure 5. Four-layer rack on the RoboRocker that securely holds standard SBS format *plates.*

Steep-tilt models are available with 2-layer or 4-layer racks that securely hold SBS-size culture plates so that even at very steep angles, your culture plates will not slide around.

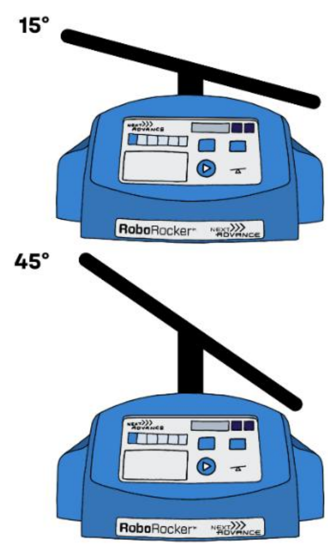

Figure 4. Comparison of a conventional rocker's 15° maximum tilt with the RoboRocker's 45° Steep Tilt capability, which produces almost 3 times greater shear flow.

Independent Forward and Reverse Motion

The angles of conventional rockers are controlled mechanically with a cam, limiting the motion to a symmetric, sinusoidal pattern. In contrast, the RoboRocker allows independent control of forward and reverse tilt speeds and angles, enabling asymmetric flow patterns. This is valuable in microfluidic devices where flow resistance differs by direction, if a one-way valve or channel is present, or when specific shear conditions must be applied selectively. For example, significant shear stress can be applied in one direction, and then the reservoirs in the culture plate can be recharged with a gentle flow in the reverse direction (see Figure 6). By tailoring flow asymmetry, researchers can better replicate physiological conditions such as arterial versus venous flow or directional transport across epithelial barriers.

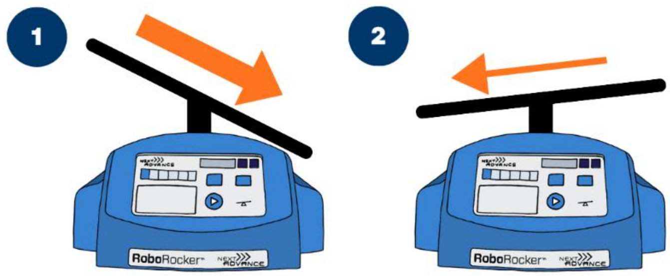

Figure 6. Step 1 – this RoboRocker is programmed to travel to 30° to generate shear stress in one direction. Step 2 – the rocker then tilts to 5° in the reverse direction to recharge culture plate with a gentle flow.

Independent Two Axis Motion Control

One RoboRocker model supports motion along two independent axes, allowing for complex flow patterns that are not achievable with traditional single-axis systems. In applications where organoids are cultured under multiple conditions, the RoboRocker can tilt along one axis, and at a specified time tilt in a perpendicular direction. This also supports circular flow paths that enhance mixing and nutrient transport, and for sequential tilting that enables multi-step culturing in plates. This is useful in facilitating biomolecular interactions among different organ cultures within the same plate to better mimic complex *in vivo* environments. Multi-axis capability broadens the experimental design space for cellular and organ cross-talk and MPS research.

Ultra-Slow and Ultra-Fast Motion

Using digital speed control, the RoboRocker can travel many times slower as well as faster than typical laboratory rockers. Ultra-slow motion enables perfusion at a nearly constant flow rate over extended periods of time. By slowly increasing the tilt angle, the RoboRocker can compensate for changing levels of culture medium in the source and waste reservoirs that would otherwise equilibrate. Some models are designed with an ultra-fast speed which allows rapid transitions to target angles, ensuring that shear exposure occurs almost entirely at the desired angle. Because of the rapid movement, these models come with racks that hold culture plates securely. Researchers have the flexibility to fine-tune flow dynamics to match specific experimental needs, from delicate organoid maintenance to high-shear stress studies.

Additional Specialized Features

Some RoboRocker models have additional programming features. One such feature is pulsatile tilting, which causes a controlled oscillatory motion to generate pulsatile flow within microfluidic channels, effectively mimicking flow patterns produced by a beating heart. Another key feature is program scheduling, whereby the RoboRocker will run one saved program for a set duration before automatically transitioning to subsequent programs. This scheduling framework supports experimental designs, such as running a program for a single cycle or several cycles, switching to a secondary program, perhaps traveling to a level position for a sensor reading, and then returning to the original program as needed. These features provide researchers with even more control over their motion protocols.

Communication with Instruments

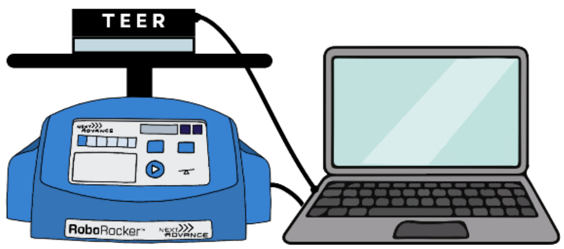

Figure 7. Example of an instrumentation setup—such as a TEER system—operating in sync with the RoboRocker. Measurements are taken at consistent conditions, with the platform held at the same angle and the same point in the rocking cycle each time, ensuring reproducible culture observations and data acquisition.

Modern laboratories often require integration between multiple instruments and custom experimental setups. As the RoboRocker is microprocessor controlled, some models support full duplex serial TTL communication. Measurements can be synced with platform position or rocker cycles. In fact, the RoboRocker can be externally controlled, allowing real-time feedback from sensors (e.g., flow, pressure, or barrier integrity measurements such as transepithelial/transendothelial electrical resistance (TEER)) to dynamically adjust rocking parameters. This transforms the RoboRocker from a standalone device into a core component of automated experimental designs.

Heavy-Duty Capacity

Certain applications require additional equipment, such as microscopes or sensing platforms, to be mounted directly on the rocker. Some RoboRockers support high load capacities, with custom configurations capable of handling 33 lb (15 kg) loads. As a result, elaborate experimental setups can be implemented without sacrificing motion precision or system stability.

Figure 8. The Heavy Duty RoboRocker can support instrumentation mounted to the platform that monitors your culture system at all times.

Customizable for Specialized Applications

Next Advance frequently tailors its rockers to meet the needs of customers with unique experimental requirements. For example, platforms can be configured to accommodate non-standard culture plates, and additional rocking parameters, such as speed, tilt angle, or load capacity, can be adjusted to suit specific workflows.

How the RoboRocker Compares to Conventional Rockers

Feature	Conventional Rocker	RoboRocker	Benefit
Continuous Incubator Use	Not rated	Designed for it	Optimal for MPS
Long-life	Typically, 1 - 2 years	Runs for many years	No mid-study failures
Defined Angle Pause	No	Any angle/duration	Consistent, regulated perfusion
Max Tilt Angle	~15 degrees	45 degrees or more	Greater shear flow
Asymmetrical Flow	Sinusoidal, symmetric	Independent forward/reverse	Unique flow profiles
2-Axis Control	No	Yes	Complex culturing motion
Ultra-Slow Speed	No	Yes	Prolonged perfusion at constant flow rate
High Speed	No	Yes	Controlled shear flow
Scheduling	No	Yes	Match rocking with culture stage
Pulsatile Flow	No	Yes	Mimic beating heart flow
External Communication	No	Customizable	Sync sensor readings, computer-controlled rocking
High Weight Capacity	No	Yes, up to 15 kg	Supports heavy instruments on rocker platform
Customizable	No	Yes	Specialized applications

Summary

With its flexibility, programmability, and proven reliability, the RoboRocker provides a powerful platform that meets both standard laboratory needs and the demands of advanced organoid and cell culture research. Whether it is used for microfluidic perfusion, shear-flow studies, multi-axis culture, or integrated instrumentation workflows, there is a RoboRocker configuration that can support any experimental need. The RoboRocker elevates rocking-based culture from a basic laboratory tool to a critical component of next-generation biological research.

Next Advance, founded in 2003, designs and manufactures its products in Troy, New York. It takes pride in the reliability of its products and the quality of their features which enable researchers to obtain precise, consistent results.

For more information on the RoboRocker, including models and specifications, visit https://www.nextadvance.com/roborocker/ or contact us at info@nextadvance.com.