Labotronics

# Microwave Reactor

## LB-10MR

info@labotronics.com | www.labotronics.com

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## 1. Introduction

**Microwave reactor LB-10MR** is a continuous flow thermochemical unit for precise control of critical reactions. Built-in PID controller ensures reproducible results. Equipped with glass tablewheels and H-shaped glass pipe for high efficiency heating. Microwave power is continuously adjustable with power meter, makes it convenient for different reaction conditions.

## 2. Features

- Door interlock switch for easy connection
- Large screen window for observation
- Adjustable stirring speed (stepless)
- Non-reactive Teflon plate frame

## 3. Specifications

| **Model No.** | **LB-10MR** |
|---|---|
| **Frequency** | 2450 MHz ± 50 MHz |
| **Power consumption** | 1100 W |
| **Output Power** | 750 W |
| **Input current** | 7.8 A |
| **Voltage** | 220 V |
| **Dimensions** | 330 x 365 x 235 mm |
| **Package size** | 480 x 540 x 540 mm |
| **Gross weight** | 20 kgs |

## 4. Applications

Used in medical, organic, inorganic, analytical, polymer chemistry, food processing and industrial laboratories for accelerating chemical reaction under controlled conditions.

# 5. Installation

## 5.1 Unpacking and checking the device

- Unpack the box and carefully remove the microwave reactor.
- Open the reactor door and gently take out all items from the chamber, checking them against the packing list.
- Inspect the reactor for any signs of damage, and ensure the door and switches are functioning properly.

## 5.2 Cut-off waveguide

- The cutoff waveguide is pre-installed at the top of the chamber.
- If it has loosened during transportation, kindly ensure it is securely tightened.

## 5.3 The PTFE plate rail

- Typically, insert the three long bolts into the screw holes on the disc and adjust the height as needed.
- Be careful to avoid contact with the bottom of the reactor.

## 5.4 Installing

1) **Operation environment**
   - It is recommended to use the device in a ventilated cabinet.
   - Ensure the device is placed on a horizontal surface.
   - Secure the top reflux or liquid-adding device with the provided experimental metal fixtures.
   - Maintain a clearance of at least 15 cm behind the device's vent; avoid placing any objects in this area.
   - Do not remove the device's feet.
2) **Power Supply**

   A stable power supply is essential for proper operation. If a stable supply is unavailable, use a dedicated power line free from other high-power electrical equipment. Ensure the line is grounded and equipped with an 8A fuse.

## 6. Working Principle

- Microwaves are high-frequency electromagnetic waves that do not inherently generate heat. In nature, microwaves are dispersed and unfocused, making them unsuitable as a direct energy source. However, by using a magnetron, electrical energy can be converted into microwaves.

- In this device, the magnetron generates microwaves with an oscillation frequency of 2450 MHz (DPS). These microwaves penetrate materials and cause high-frequency vibrations when the material has a suitable dielectric constant and dissipation factor. This vibration accumulates energy within the material. In chemical reactions, this results in both thermal and non-thermal effects.

- Microwaves are absorbed by polar mediums and metal powders but can penetrate non-polar materials such as glass, ceramics, and PTFE. On the other hand, they are reflected by metal surfaces. The output power of the magnetron is generally consistent; power adjustments are made by varying the current's on/off duration (duty cycle).

- The device features microcomputer control for simpler and more precise operation. By selecting the same working conditions, repeated chemical reactions can be achieved reliably.

# 7. Operations

## 7.1 Control Panel

On the control panel, you will find number keys, function keys, a display screen, a power meter, a power control knob, a magnetic stirring switch, and an adjustment knob.

1) **Setting Time**
   Press the number keys to set the reaction time, then press the Start button.

2) **Power Control**
   - Rotate the power control knob clockwise (initially quickly, then gradually) until the desired power reading is displayed on the power meter.
   - Note that the magnetron tube requires a minimum voltage to start vibrating; microwave power will not be output until this voltage is reached.
   - After completing the reaction, avoid adjusting the power setting if the next experiment requires the same output power—simply set the time.

3) **Press the Clear key if you need to stop the ongoing experiment.**

4) **Adjust the reaction time.**
   Press the Clear key first, then press the number keys.

5) **Pause Experiment**
   - Press the Pause key to temporarily suspend the experiment during the reaction.
   - To resume, press the Activate key, and the microwave will continue with the originally set program.
   - If stirring the liquid in the beaker is required, turn on the magnetic stirring switch and adjust the stirring knob to the desired speed.

6) **Buzzer Signal**
   - The buzzer will sound when a key is pressed correctly.
   - If there is no sound, it indicates that the reactor has not received the signal.
   - After the reaction is completed, the buzzer will sound six times.

7) **Display Screen**
   - When the microwave reactor starts up, the screen displays "00:00."
   - The first two digits represent minutes, and the last two represent seconds.
   - While setting the response time, the cursor will flash on the first digit and move back as each digit is entered.
   - The microwave will not operate or allow modifications until all four digits are set.
   - Press the Activate key, and the screen will show the countdown timer with the set time until the program ends.

## 7.2 Operation Procedures

**1) Materials drying**

- When drying damp materials, such as silicone for dehumidification, they can be placed directly on the glass turntable for drying.
- After the operation, allow the glass turntable to cool down completely before placing it in water to prevent bursting.

**2) Sealed tube test**

Ensure the following safety precautions are observed to protect both the operator and the microwave reactor:

- Do not perform sealed tube tests for reactions that produce gases.
- The sealed tube must be made of 95-pressure-resistant glass, and the quantity of reaction material must be strictly controlled.
- For added safety, place the sealed tube inside a plastic microwave-safe box before placing it on the glass turntable and starting the reactor.

**3) Liquid or liquid / solid phase chemical reaction**

- For a small amount of reactant with no stirring required, use a 50 mL or 100 mL flask. Place the PTFE plate at the center bottom of the oven and insert the straight adapter into the flask through the closing catheter from the top of the oven. Finally, attach the appropriate reflux device to the top of the oven.

- For a larger amount of reactant or when stirring is needed (note: only use glass or PTFE stir bars; metal stir bars are not allowed), use a 250 mL or 500 mL flask. First, connect the stir bar with the H-type tube and the concave-type (凹) tube. Then insert the stir bar into the flask through the top of the reactor. Lastly, mount the reflux device and the dropping funnel.

**4) Chemical solid-state reaction**

Adjust the reaction vessel and operation procedures based on the specific requirements of different experiments, following these principles:

- Corrosive and irritating gases can damage the circuit and computer board. For reactions that produce gases, always mount a reflux device and ensure the gas is exhausted through a proper tube.
- Reactants and products often have different dielectric constants and dielectric losses, leading to varying absorption of microwave energy. Over time, this can create localized temperature differences. During solid-state reactions, it is essential to mix and stir the reactants periodically and use low output power to ensure a uniform reaction.
- Never place chemical reactants in an open container inside the microwave reactor, as this can lead to splashing and contamination of the chamber. Similarly, do not use sealed containers without safety devices, as they may explode under pressure.

# 8. Maintenance

## 8.1 Cleaning

After the reaction, the operator should inspect the chamber for any water mist, chemical residues, or other byproducts. If found, ensure they are thoroughly cleaned.

- Use a slightly damp, soft cloth to clean the cavity walls and door, followed by wiping them with a dry, soft cloth. Avoid using rough or abrasive detergents or scrubbing materials.
- Clean the outer housing with a slightly damp cloth, ensuring no liquid enters the chamber.
- When cleaning the control panel, keep the door open to prevent accidental activation.
- After cleaning, press the Clear key to remove any numbers displayed on the screen.

## 8.2 Washing

- Wash the glass turntable, swivels, and PTFE tray with hot soapy water.
- Rinse thoroughly with clean water and dry them for future use.
- Failure to clean these components may result in noise during the reaction and could absorb microwave energy, interfering with the chemical reaction.

## 8.3 Fan

- The fan in this device is designed to run continuously for cooling, degassing, and circuit dehumidification.
- Be sure to operate the device regularly during the wet season to prevent moisture buildup.

## 8.4 Dehumidification

- Remove the flask immediately after the operation and close the door.
- The fan will continue running for at least ten minutes to exhaust gas and mist.
- Afterward, turn off the power.

## 8.5 Stops for long

- Before the holidays, ensure the reactor is thoroughly cleaned.
- Remove all glass components, clean the chamber, and run the fan for at least ten minutes. Place the small cap on top of the cutoff waveguide, insert the silica gel desiccant into the chamber, and then close the door.