

## LABOTRON EXTRACTION & SYNTHESIS 2450 MHz

The LABOTRON™ series is the generic name for a ground breaking range of integrated reactor and microwave transmission systems especially designed to carry out microwave-assisted processes in batch or in continuous flow. The LABOTRON implements SAIREM's patented INTLI (internal transmission line) technology together with the U-waveguide, WO 2009/122101 and WO 2009/122102.



Fig. 1. LABOTRON™ 6 kW with batch reactor



Fig. 2. LABOTRON™ 2 kW with CF reactor

The LABOTRON™ provides enhanced safety, assured process compatibility, minimum footprint and reduced cost of ownership compared to the more conventional approach of microwave-assisted systems. A centralized control strategy allows for energy conservation. Other benefits include lower installation costs and shorter installation time.

The principle of the microwave-assisted processing using INTLI is to bring, very selectively, a great quantity of energy **directly** inside the reaction mixture. The LABOTRON can cover a wide area of chemical processes enabling efficient and reproducible syntheses from a few grams/hour to more than 1 kg/hour. The INTLI technology brings new prospects to the microwave chemistry and in particular, to the possibility of scaling-up processes in continuous flow.

The LABOTRON improves considerably the performance of microwave-assisted chemistry due to:

- Optimized geometry of the INTLI to achieve high power densities inside the reactor, up to several kW/L;
- Microwave energy can be selectively concentrated inside the reaction by using a solvent relatively transparent to microwaves;
- The external cooling via a metallic jacket can maintain the reagents and their products at very low temperatures to avoid the degradation of the delicate molecules;

- Continuous flow or batch mode process;
- Direct reading of forward and reflected power values to enable the correct calculation of the energy absorbed by the irradiated sample.

Other advantages are:

- Automatic impedance tuning for minimal levels of reflected power and maximum efficiency of the microwave-assisted process;
- Quick-connections for increased flexibility and rapid cleaning & maintenance;
- Possibility of quick-adapting several types of reactors – standard or custom made - on the **same** microwave head;
- Possibility of scaling-up at 915 MHz if the required microwave power is higher than 6 kW;
- Batch reactor: efficient mechanical stirring with adjustable speed;
- PLC-based controller and touch screen user interface; all system functions and status, including recipe changes, alarms and chemical levels are accessible from the touch screen display;
- On-line reagents addition and products removal & sampling;
- Based on a mobile platform for quick installation and positioning.

## OPTIONS

The LABOTRON is supplied with a choice of two microwave generators, i.e. 6 kW (Fig. 1) and 2 kW (Fig. 2) and a choice of microwave-assisted reactors, which include batch reactors and continuous flow reactors. The exact choice of technology is driven by the process type, the process recipe and customer requirements pertaining to utility availability, cost of ownership and chemical performance.

1. **LABOTRON X** – system designed to carry out microwave-assisted extraction from laboratory scale up to industrial scale;
2. **LABOTRON S** – system designed to perform microwave-assisted synthesis from laboratory scale up to industrial scale.

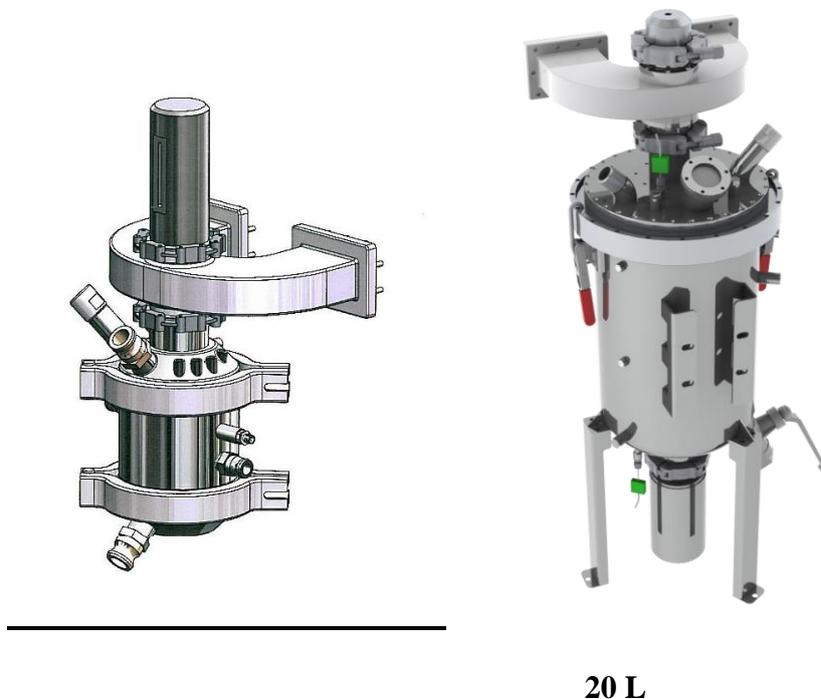
Two types of reactors are available with the LABOTRON:

- ***Batch reactor*** with volumes from 1.5 L up to 20 L (Fig. 3a) within which the INTLI is placed in the middle of the reactor in direct contact with the reaction mixture. The reactor is made out of high quality stainless steel and features an external cooling jacket and internal stirring system by mechanical stirrer. The reactor & INTLI can be fully lined with PTFE or Hastelloy to ensure that any solvents and acids can be safely employed. Other features of the batch reactor include: ¼ inch Swagelock fitting and mass flow meter for gas (nitrogen, air etc.) usage, connection for a condensation/distillation column, up to 4 thermometers (optical fibre or thermocouple), port for reagent addition as the reaction proceeds (without the need of turning the microwaves off), for on-line sampling etc. The cooling of the reactor can be controlled and programmed as such that cooling will be ON only if necessary; the control of this function is driven by the reaction temperature;
- ***Continuous flow (CF)*** reactor features SAIREM's innovative SPIN reactor (Fig. 3b) proven to improve yield, selectivity and safety of liquid-liquid and liquid-vapour reactions. Temperature measurement and control is available via a thermocouple installed at the exit of the reactor.

The LABOTRON™ has a very degree of versatility: all reactors are easily interchangeable and the connections are made via standard quick-release connectors. The same system can be easily configured to perform numerous applications including solvent extraction, chemical synthesis, hydrolysis etc. at laboratory scale and industrial scale.

The LABOTRON™ contains built-in proprietary software safeguards (**R**eactor **A**ctive **R**ecognition **C**ontrol) that disallow programming to unsafe combination of power and reactor type. The RARC software is easy to use, self intuitive with control style which can be selected for any method or reactor from ramp to temperature and ramp to microwave power, set-point control, multiple ramps, time, recipe choice & storage etc.

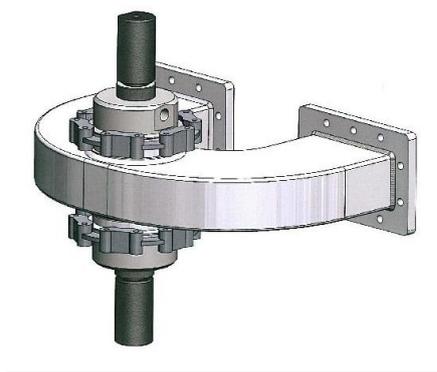
The LABOTRON™ has numerous standard safety features and interlocks that automatically monitor and control the operation to ensure safe and reliable functionality at all times: continuous microwave power control, pressure and temperature sensors, load sensing, microwave leak detection.



1.5 L

20 L

**Fig. 3a. Batch reactors mounted on the U-shaped waveguide**



**Fig. 3b. SPIN (continuous flow) reactors mounted on the U-shaped waveguide**

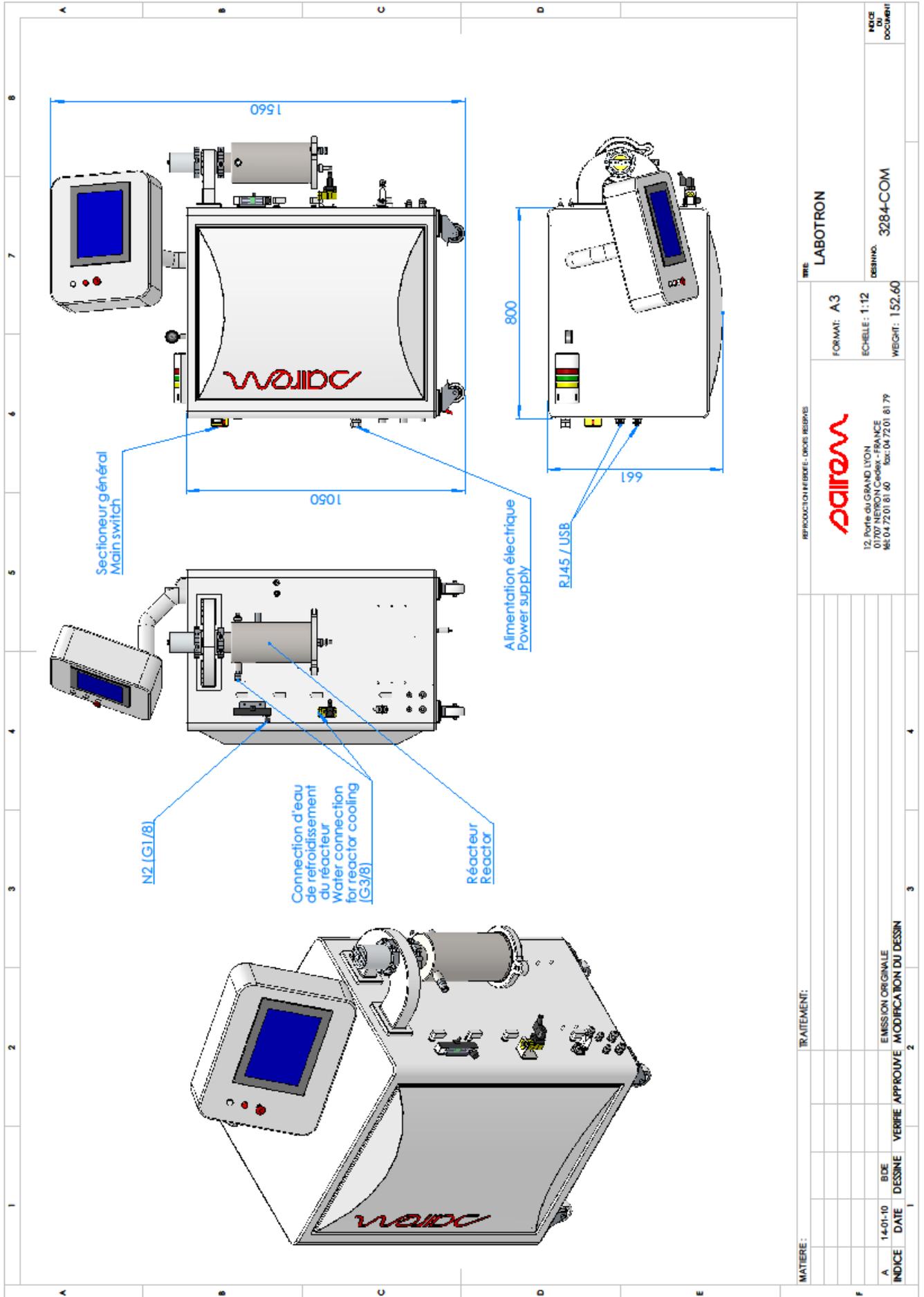
## MAIN TECHNICAL PARAMETERS

REF.		LABOTRON X or LABOTRON S
Microwave frequency		2450 MHz
Maximum microwave power		2 kW continuous wave (CW) or pulsed, adjustable from 0 W to 2000 W
		6 kW continuous wave (CW) or pulsed, adjustable from 600 W to 6000 W
Microwave tuning		Auto-tuner
Control		<ul style="list-style-type: none"> <li>- Forward power, reflected power and temperature via integral PLC/digital display</li> <li>- Touch screen: coloured 12 inch display, protected against chemical splashes</li> <li>- Data registration: data logging ports RJ45 and USB</li> </ul>
Safety		<ul style="list-style-type: none"> <li>- Reactor Active Recognition Control</li> <li>- Pressure release valve at 1.5 bar</li> <li>- Inside cabinet pressure switch</li> <li>- Isolator for magnetron protection from reflected energy and to assure constant power output</li> <li>- Retractable drip tray to contain any accidental fluid leaks, splashes etc.</li> <li>- Anti-splash display protection</li> <li>- Cabinet painted in anticorrosive paint</li> <li>- Visible (red, yellow, green) signal tower and sounder</li> <li>- Hardwired microwave leak detector</li> </ul>
Temperature measurement & control		<ul style="list-style-type: none"> <li>- Optical fibre (from -80 up to 250 °C)</li> <li>- Thermocouple type K, Inconel, up to 950 °C</li> </ul>
Reactors	Batch	<ul style="list-style-type: none"> <li>- Volume from 1.5 L to 20 L; to be specified with order;</li> <li>- Material of construction: stainless steel*</li> <li>- Cooling: water</li> <li>- Working pressure: max. 1.1 bar</li> <li>- Stirring: mechanical stirrer with adjustable speed</li> </ul>
	SPIN CF	<ul style="list-style-type: none"> <li>- Volume 40 ml</li> <li>- Material of construction: borosilicate glass (Pyrex)**</li> <li>- Integral pump with adjustable flow</li> <li>- Cooling: silicone oil (oil bath not supplied)</li> </ul>
INTLI		Aluminium or anticorrosion protected aluminium
Power requirements – supply		<b>2 kW system:</b> 1-phase 240 V 50/60 Hz; 3 x 208 V 50/60 Hz
		<b>6 kW system:</b> 3-phase 400 V, 208 V, 50/60 Hz
Microwave generator cooling		<b>2 kW system:</b> Water, min. 4 L/min
		<b>6 kW system:</b> Water, min. 10 L/min
		With integrated electrovalve for control. T <sub>water</sub> = 18 – 25 °C, T <sub>ambient</sub> = max. 40 °C
Dimensions (H x L x W) mm Each side panel requires 650 mm when fully opened		<b>2 kW system:</b> 1560 x 661 x 1100 (with U-waveguide and reactor mounted)
		<b>6 kW system:</b> 1600 x 900 x 1100 (with U-waveguide and reactor mounted)

\* Other metals could be also ordered, e.g. hastelloy. Inconel etc.

\*\* Fused silica (Quartz) on request





MATERIE:		TRAITEMENT:		REPRODUCTION INTERDITE - DROITS RESERVES		SIRE LABOTRON	
A		14-01-10		EMISSION ORIGINALE		FORMAT: A3	
INDEXE		DATE		VERIFIE APPROUVE		ECHELLE: 1:12	
				MODIFICATION DU DESSIN		DESIGNO. 3284-COM	
						WEIGHT: 152.60	
						INDEXE DU DOCUMENT	