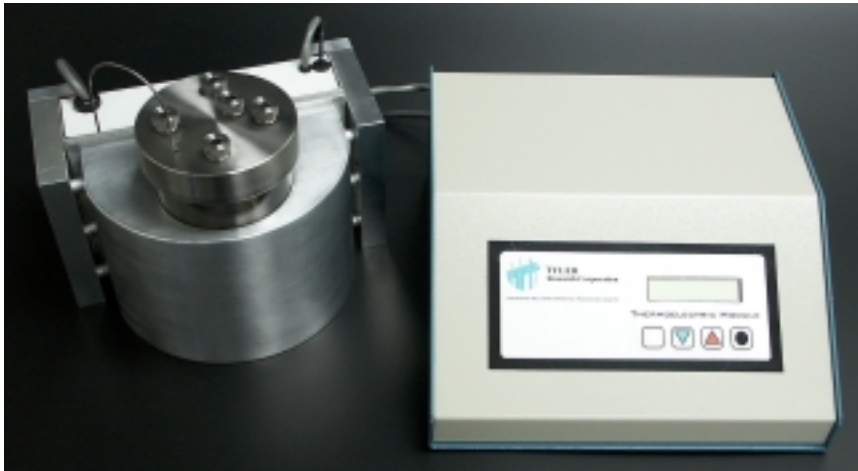
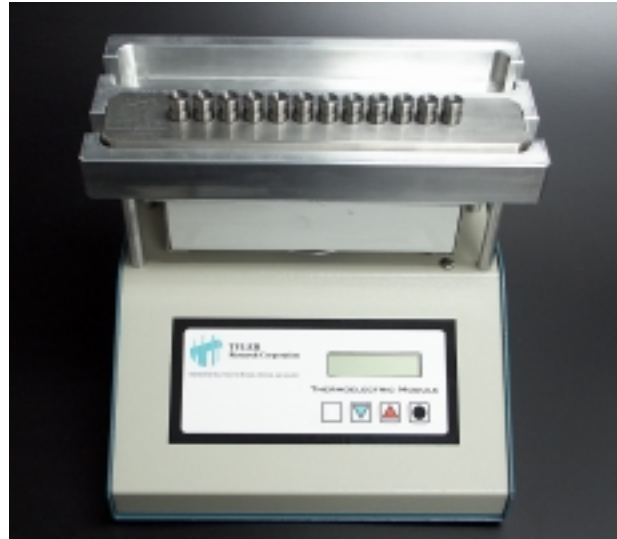


# Tyler Research Corporation

## Thermoelectric Modules

Tyler Research Thermoelectric Modules provide for precise digital thermal control of biofilm devices. Standard systems are available for the LPMR-12 series manifolds in acrylic, PVC and stainless steel configurations, and for the CHEM-500 chemostat culture system. Other devices may be accommodated through special order. The systems are designed to maintain stable temperatures from approximately +4°C to +55°C under standard laboratory conditions.

The modules consist of a thermoelectric heat pump embedded in an aluminum ingot machined to accept one or two specific biofilm devices. A low-voltage, high-current DC circuit under microprocessor control drives the heat pump. Solid-state sensors embedded in the aluminum ingot provide feedback to the microprocessor, which functions as a proportional integrating controller. The desired temperature is programmed by means of a front panel keypad, indexing the setpoint in one-degree increments up or down. The setpoint is displayed on an LCD display, along with the actual temperature and the power consumption of the driver circuit. A turbofan dissipates waste energy (heat or cold, depending on whether the module is maintaining a setpoint below or above ambient temperature).



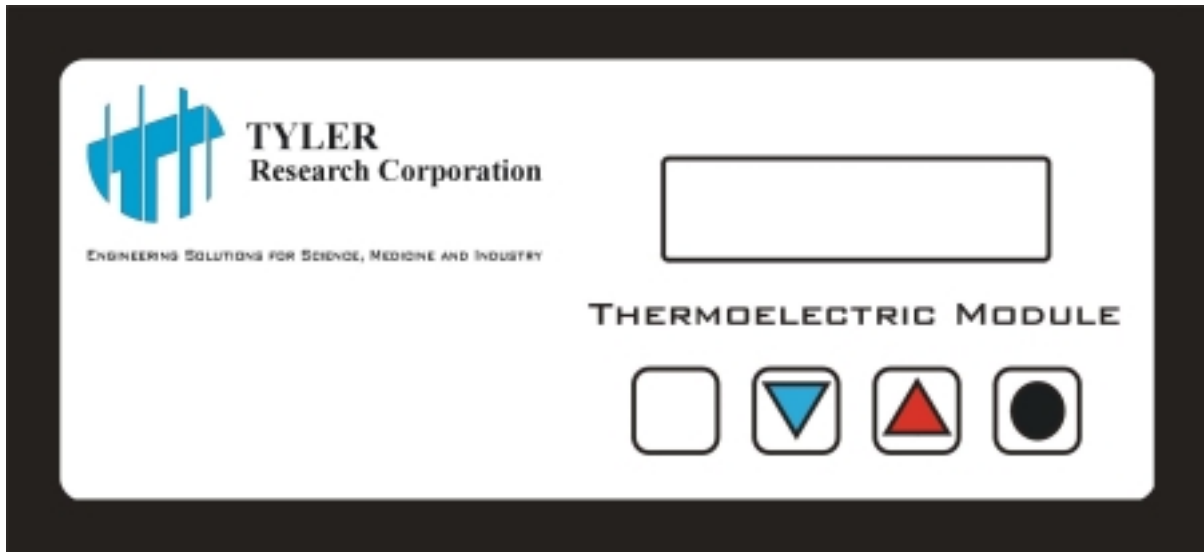
Due to the large mass of the ingot and biofilm device, it is recommended that the modules be activated prior to initiating an experimental run. This will permit the components to equilibrate at the desired temperature, and usually requires five to fifteen minutes depending on the set point and the volume being maintained.

Thermoelectric modules are available in 110V or 220V versions.

## Calibration Procedure

Tyler Research Thermoelectric modules are calibrated in our laboratories before shipment, and further calibration should not be required. However, an automatic calibration procedure is programmed into the microprocessor in the unlikely event re-calibration becomes necessary.

Place water in the well of the aluminum ingot, forming a temporary dam with electrical tape if necessary to permit containment. Place an accurate thermometer or thermocouple in the water to act as a reference, and cover the aluminum ingot with insulating material. Ensure, however, that airflow to and from the heat pump module is not restricted by the insulation.



Access the automatic calibration function by turning off the main power using the rocker switch on the right rear panel. Depress all three of the labeled buttons on the front panel simultaneously, and turn the main power on *while keeping these switches depressed*. After characters appear in the LCD display, release the front panel buttons. The device will then enter auto-calibrate mode.

In auto-calibrate mode, the device will attempt to drive the temperature to 0°C and will give a constant readout of temperature as it does. Check the temperature of the reference thermometer or thermocouple against the LCD display and correct the display as required. If, for example, the LCD display reads 0°C and the reference reads 2°C after steady state has been reached, depress the increment button (red triangle) on the front panel of the module twice to bring it to a reading of 2°C. The module will then reduce the temperature of the ingot to bring it to 0°C. When both the reference and the display read 0°C, depress the "Enter" button (black circle). This saves the point in memory, and automatically directs the module to drive the temperature to 60°C. Repeat the correction procedure at the high end of the curve. If, for example, the reference thermometer reads 57°C and the display reads 60°C after steady state has been reached, depress the decrement button (blue triangle) on the front panel of the module three times to bring it to a reading of 57°C. The module will then increase the temperature of the ingot to bring it to 60°C. When both the reference and the display read 60°C, depress the "Enter" button (black circle). This will save the high point in memory, recalculate the slope of the temperature curve, and establish a new calibration curve. The unit will then automatically enter standard mode, and a new setpoint can be programmed into the module.