[iMSPR Pro Series TCU Technical Guide]

Smart Thermal Balance: Compact Design, Optimized Efficiency

The Thermal Control Unit (TCU) of the iMSPR Pro is engineered with a focus on practical efficiency and signal. By adopting a direct contact-type architecture instead of a bulky air-bath system, we maximize space efficiency while rapidly delivering the precise data required by researchers.

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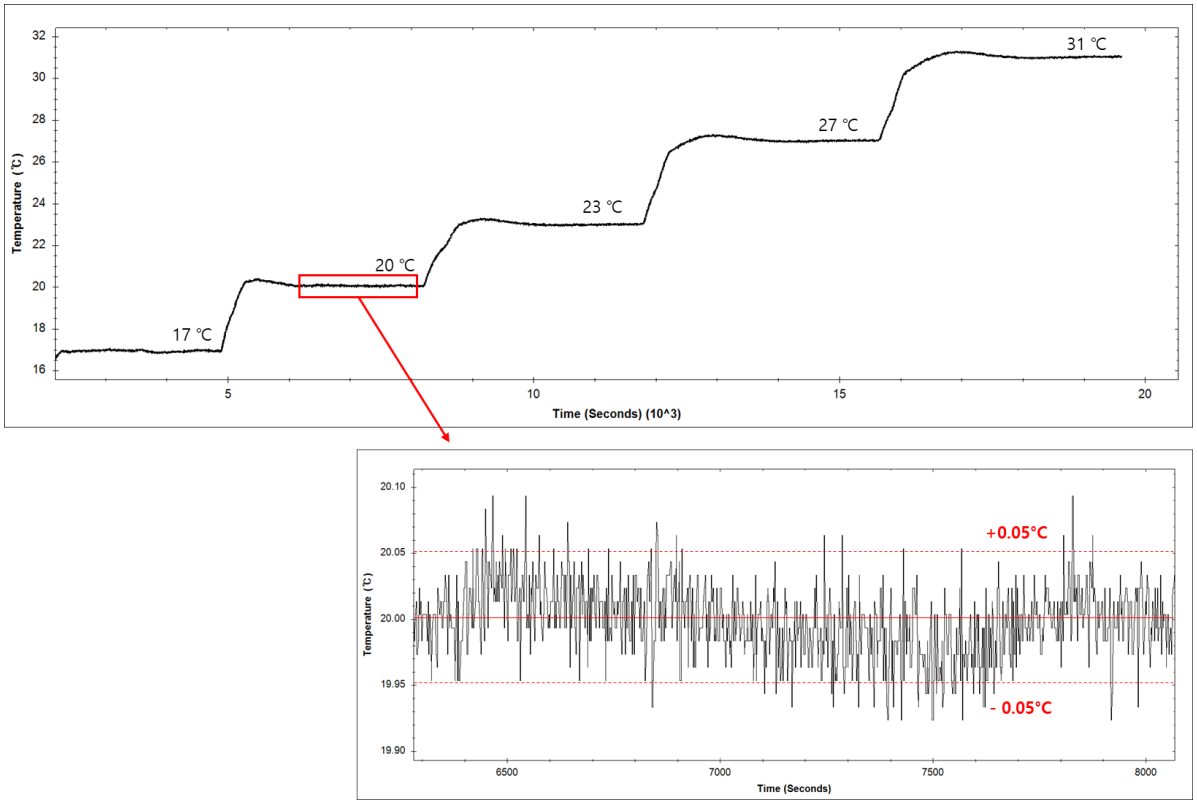
1. Hardware Performance: Precision Meets Speed

The iMSPR TCU focuses on achieving a state of thermal equilibrium optimized for high-sensitivity SPR experiments, rather than merely maintaining an absolute isothermal state.



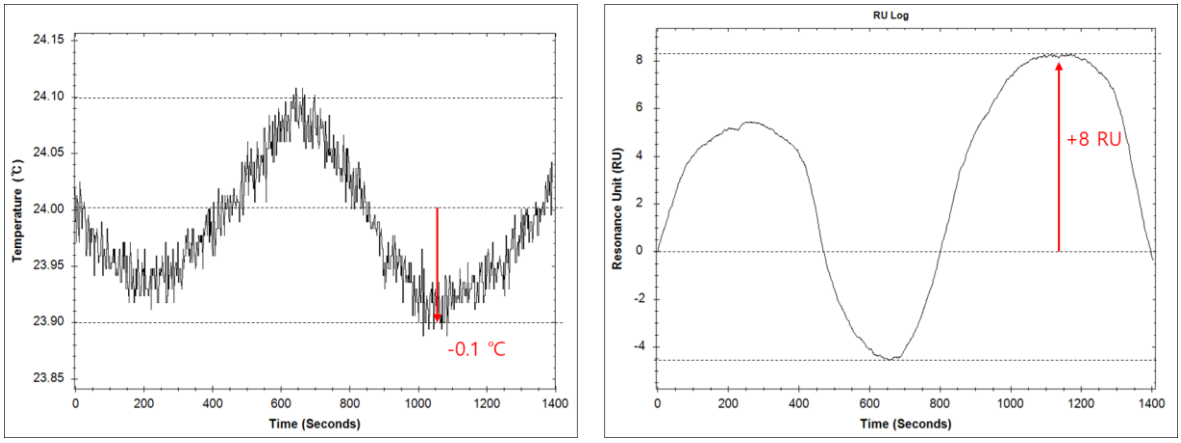
[Overview of iMSPR TCU temperature control/stabilization]

- Intrinsic Noise (Core Performance): The inherent optical noise level of the iMSPR Pro is below 0.1 RU (RMS), ensuring industry-leading detection sensitivity.
- Control Range & Precision: Adjustable within 10–40 °C (within ±10 °C of ambient). Once the steady-state is reached, the system maintains a temperature deviation of approximately ±0.1 °C.

- Direct Heat Exchange: The Peltier element is in direct contact with the sensor block, ensuring intuitive temperature control with minimal thermal loss compared to convection-based systems.
- Optimized Thermal Dynamics: The new Prism Holder 200 features optimized thermal mass, improving the time to reach the target temperature by approximately 17% compared to legacy models.

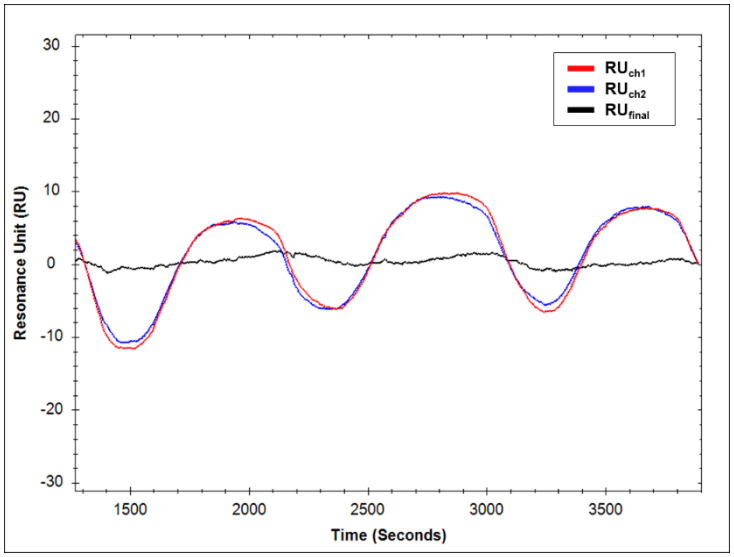
2. Adaptive Precision: Managing Physical Trade-offs

In high-precision SPR analysis, a minute temperature change of 0.1 °C can physically manifest as a signal fluctuation of 10–15 RU. The iMSPR Pro addresses this through a synergy of hardware and software:



[(Left) Temperature change over time, (Right) SPR signal change over time]

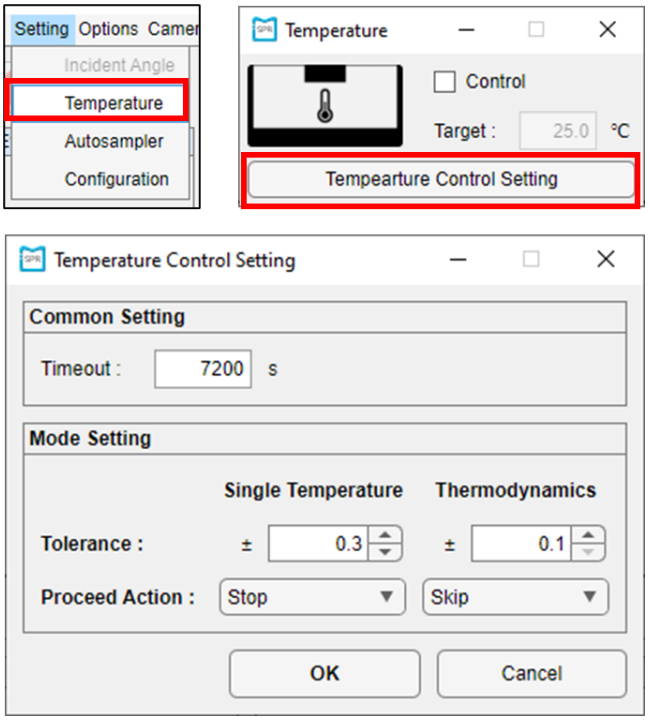
- Signal Correction via Referencing: Refractive index fluctuations due to temperature changes appear with the same timing and pattern in both the Analysis (Ch1) and Reference (Ch2) channels. By subtracting the reference channel data, common-mode thermal drift is removed to extract the pure binding signal.
- Baseline Stability (Effective Stability): By canceling out raw data fluctuations through referencing, the system achieves a highly stable and practical baseline, typically within 1–2 RU.



[Signal referencing by subtracting Ch2 data]

3. Software Parameter Optimization

Control parameters can be optimized for specific experimental goals via the Setting – Temperature – Temperature Control Setting menu in the iMSPR software.



[Software setting window]

[Insert Image: Software setting window]

- Timeout (Max Wait Time): The maximum duration (seconds) to wait for the temperature

to reach the target range. For precision experiments, it is recommended to set this high enough (up to 10,800s) to allow the system to reach full thermal equilibrium.

- Tolerance (Acceptable Range): The allowable error range for the target temperature. Set this to the minimum (0.1 °C) for precision analysis, or widen it (0.5 °C) for quick screening to shorten waiting times.
- Proceed Action: Determines the action if the tolerance is not reached within the timeout. Select Stop to start experiments only under perfect conditions, or Skip to proceed while accepting minor deviations.

4. Operational Guidelines for Optimal Stability

[Environmental Optimization]

- **Standard Operating Environment:** Maintain a laboratory temperature of 20±5 °C and humidity below 45 %RH to reduce the thermal load on the hardware.
- **Installation Location:** Ensure that direct airflow from air conditioners or heaters does not hit the equipment. Rapid changes in external airflow can trigger excessive compensation behavior from the TCU.

[Flexible Control Strategy]

- **Passive Mode**: If the target temperature is similar to the laboratory ambient temperature, conducting experiments in an Ambient Equilibrium (Passive Mode) without active TCU operation can be advantageous for obtaining a signal free of control noise.

"The TCU of iMSPR-Pro series is more than just a heating device; it is a sophisticated, intelligent thermal management system that ensures data reliability in real-world laboratory conditions."
