Thermostat mode is an automatic control strategy for shed cooling (P2) that uses short gravity-fed spray bursts to hold the internal shed temperature below a configurable threshold, and escalates to continuous cooling if the shed is heating too quickly.

Thermostat mode is intended to:

- Keep the shed structure cooler during hot or pre-fire conditions with **minimal water use**, using short, gravity-only sprays.
- Automatically escalate to **continuous shed cooling** if the shed begins to heat faster than normal (indicating severe ambient or fire-front conditions).
- Operate consistently in both **REMOTE** and **AUTONOMOUS** modes, with clear rules for when it is enabled, overridden, or disabled.

---

2. Core Behaviour

Thermostat mode is defined by three main parameters:

- **InternalTempThreshold**: default **47 °C**
- **PulseOnTime**: default **1 minute** (P2 ON)
- **MinGapForContinuous**: default **2 minutes** (minimum allowed time between the *start* of successive cooling pulses)

Optional hysteresis may be applied:

- **ThresholdReset**: e.g. **45 °C**, to avoid rapid retriggering when the sensor is noisy.

Normal thermostat action (pump OFF):

1. When internal shed temperature **rises to or above 47 °C** after having cooled below the reset level:
   - Shed cooling (P2) is turned **ON for exactly 1 minute** (gravity feed only).
2. After 1 minute, P2 is turned **OFF**, regardless of the temperature.
3. The next thermostat pulse is only allowed once the internal temperature has dropped below the reset level and then risen again to the threshold.

Escalation to continuous ON:

- For each thermostat pulse, the system records the **start time**.
- If the interval between the start of the current pulse and the start of the previous pulse is **less than 2 minutes**, thermostat mode considers the shed to be heating too rapidly.
- In this case, thermostat mode **escalates to continuous shed cooling**:
   - P2 is turned **ON and held ON** (subject to water-level / gel constraints).
   - Thermostat pulsing is suspended while in this continuous state.

A global safety rule still applies:

- If internal temperature exceeds a higher critical threshold (e.g. **INT > 60 °C**), shed cooling is forced **continuous ON**, regardless of thermostat timing.

---

3. Behaviour in REMOTE Mode (AR1 + HA)

In REMOTE mode (heartbeat active), shed cooling is nominally controlled via the existing **shed cooling switch** and its cycle time parameters (`timeOn2`, `timeOff2`). Thermostat mode is integrated using the following convention:

- The shed cooling switch (`peripheral2State`) must be **ON** for any automatic shed cooling to occur.
- The meanings of the cycle parameters when the switch is ON are:

`timeOn2`	`timeOff2`	Behaviour (REMOTE)
0	0	**Thermostat mode** (new behaviour)
>0	0	Forced continuous ON (explicit override)
0	>0	Forced OFF (explicit override)
>0	>0	Timed intermittent schedule (explicit)

- When **thermostat mode is active** (`peripheral2State = ON`, `timeOn2 = 0`, `timeOff2 = 0`):
  - AR1 monitors the internal shed temperature received from AR3.
  - It applies the thermostat algorithm described above:
    - Widely spaced 1-minute pulses when heating is slow.
    - Escalation to continuous P2 ON if pulse intervals shrink below 2 minutes.
- Any **non-zero** timing values (`timeOn2`, `timeOff2`) represent **explicit operator or HA control** and **override thermostat mode**.
- When the shed cooling switch is **OFF** (`peripheral2State = 0`), thermostat mode is disabled and P2 is held OFF.

---

4. Behaviour in AUTONOMOUS Mode (AR3)

In AUTONOMOUS mode (RS-485 / MQTT supervision lost, AR3 in full control), thermostat mode is used to protect the shed structure while still conserving water when the pump is not required.

Pump OFF:

- When the system is in AUTONOMOUS mode, water level is in a band that permits shed cooling, and the **pump is currently not requested** by other fire logic:
  - AR3 applies the **same thermostat algorithm** to P2:
    - 1-minute gravity-fed pulses at or above 47 °C.
    - Monitoring of the interval between pulses.
    - Escalation to continuous P2 ON if the interval between pulse starts falls below 2 minutes.

Pump ON:

- Once the **pump is turned ON** in AUTONOMOUS mode (due to external fire conditions, water-level logic, or other triggers), the system **promotes shed cooling to continuous ON**:
  - P2 is held ON together with the pump, as long as water-level and gel constraints allow.
  - Thermostat pulsing is no longer used while the pump remains ON.
- The critical over-temperature rule (e.g. INT > 60 °C ⇒ P2 continuous ON) still applies and can also cause or reinforce continuous P2 operation.

---

5. Enable/Disable Summary

- **Thermostat mode is active only when explicitly allowed by configuration:**
  - **REMOTE**: shed cooling switch ON, `timeOn2 = 0`, `timeOff2 = 0`.
  - **AUTONOMOUS**: `fsMode = AUTONOMOUS`, pump OFF, water in a permissible band.
- **Thermostat mode is overridden or disabled when:**
  - Shed cooling switch is OFF in REMOTE.
  - Non-zero cycle times are configured in REMOTE (explicit operator schedule or continuous).
  - The pump is ON in AUTONOMOUS (shed forced continuous with pump).
  - Water level / gel logic forbids shed cooling.

This provides a unified, water-efficient shed protection strategy that behaves consistently across REMOTE and AUTONOMOUS modes, with a clear and predictable escalation path from low-duty thermostat pulsing to continuous cooling under high thermal load.