# **Operation Instructions Stanley Steamer V1.0.0**

# IDLE mode

Heater is off, pump is off.

Measures temperatures and pressure.

Serial, MQTT and SD card data logging active.

Enters shutdown after 15 minutes of no user activity

Input controls:

CENTER – starts PREHEAT mode.

UP – enters SHUTDOWN mode

DOWN – starts PREHEAT mode

LEFT – turns off pump (for priming)

RIGHT- turns on pump for priming

WHEEL – Change setpoint +/- 1°C

# PREHEAT mode

Powers heater at 100% for a calculated amount of time (based on starting ΔT). After full power time enters a PAUSE period for 30 seconds with no power (M=0%). Changes to relay control mode (with 0%/6% output limits) and enters WAITING mode where it waits for thermal stability at setpoint. Changes to STEAM mode once stability is achieved.

Serial, MQTT and SD card data logging active.

Input controls:

CENTER – goes to STEAM mode

UP – exits preheat goes to IDLE mode

DOWN – no action

LEFT – increase pump cycle interval time by 0.5 seconds (less steam)

RIGHT – decrease pump cycle interval time by 0.5 seconds (more steam)

WHEEL – adjusts steam time by +/- 10 seconds.

# STEAM mode

Upon entering steam mode, the heater relay limits are set to 0% and 6% to maintain setpoint (no fluid flow conditions) and waits for cycle initiation.

When the steam cycle is initiated the heater relay outputs are set to 80% and 100% and pump cycling begins. Cycling continues until user cancels or the period time expires. The heater outputs return to 0% and 6% after the pump cycling ends to maintain setpoint. After 10 minutes of no user input activity, the system changes to IDLE mode.

Serial, MQTT and SD card data logging active.

Input controls:

CENTER – initiates/cancels steam cycle.

UP – goes to IDLE mode

DOWN – pulse pump one extra cycle

LEFT – increase pump cycle interval time by 0.5 seconds (less steam)

RIGHT – decrease pump cycle interval time by 0.5 seconds (more steam)

WHEEL – adjusts steam cycle time by +/- 10 seconds.

# SHUTDOWN mode

Upon entering SHUTDOWN mode heater and pumps functions stop. LCD is turned off. All data logging stops. Any key press causes the system to exit shutdown mode and enter IDLE mode.

Input controls:

CENTER – goes to IDLE mode.

UP – goes to IDLE mode.

DOWN – goes to IDLE mode.

LEFT – goes to IDLE mode.

RIGHT – goes to IDLE mode.

WHEEL – no change.

# Serial/MQTT text commands:

|  |  |  |  |
| --- | --- | --- | --- |
| **Heater Commands:** | | | |
| **SP** | = | nnn | Changes active setpoint to nnn |
| **OUT** | = | x.x | Change heater output to x.x%, leaves control in current mode (manual or automatic). |
| **PID** | = | n | Change PID control mode to 0 for manual, or 1 for automatic. No change to current heater output. |
| **KP** | = | x.x | Changes PID parameter KP to x.x |
| **KI** | = | x.x | Changes PID parameter KI to x.x |
| **KD** | = | x.x | Changes PID parameter KD to x.x |
|  |  |  |  |
| **RC** | = | ON | Starts deadband relay control mode |
| **RC** | = | LOW | Start relay control (TD=2, OL=90.0, OH=100.0) |
| **RC** | = | HIGH | Start relay control (TD=2, OL=90.0, OH=100.0) |
| **RC** | = | OFF | Cancels relay control mode and resumes automatic PID control |
| **TD** | = | x.x | Changes Tdelta to x.x (deadband temperature) |
| **OH** | = | x.x | Output when temperature falls below lower deadband temperature |
| **OL** | = | x.x | Output when temperature exceeds upper deadband temperature |
|  |  |  |  |
| **OTR** |  |  | Resets OTC flag and resumes automatic PID control (only if T<OTC) |
|  |  |  |  |
| **Pump Commands:** | | | |
| **CT** | = | nnnn | Change pump cycle time to nnnn milliseconds. |
| **PC** | = | n | Change pump flow pulse index to n counts. |
| **FF** | = | x.x | Change pump flow factor to x.x (mL/count) |
| **PUMP** | = | ON | Turn on pump (constant on for priming) |
| **PUMP** | = | OFF | Turn off pump |
| **FLUID** | = | WATER | Changes setpoint and pump counter factor to water (160°C, 0.2567 g/pulse) |
| **FLUID** | = | FOG | Changes setpoint and pump counter factor to water (160°C, 0.363 g/pulse) |
|  |  |  |  |
| **Data Commands** | | | |
| **TS** | = | hh:mm:ss | Syncs RTC time to hh:mm:ss |
| **MQTT** | = | nnnn | Changes MQTT data updating time to every nnnn mSec (0=off) |
| **SD** | = | nnnn | Change SD card logging time to every nnnn mSec (0=off) |
| **USB** | = | nnnn | Change USB serial logging time to every nnnn mSec (0=off) |
|  |  |  |  |
| **System Commands:** | | | |
| **OFF** |  |  | Enters SHUTDOWN mode |
| **REBOOT** |  |  | Reboots the ESP32 |

# DATA logging:

Logs data to serial port (USB if connected), sends data to MQTT on topic steamer/data, listens for MQTT commands on topic steamer/cmd, writes data to SD card (if present).