SmartPID BBQ PRO – user manual

21-07-2019

Version 1.0

Information

Revisions

Date	Version	Changes to document
21/07/2019	1.0	Initial version

Table of Contents

Ensure that the product is always used as per specification.

Do not use the product near to flammable gas and/or explosive in order to prevent unpleasant accidents.

Do not disassemble, change or touch internal parts of the product in order to avoid damage or malfunction of the same.

Do not exceed nominal power of the outputs.

Do not touch terminals during operation.

Do not let pieces of metal or electrical wires, iron chippings or fillings in the product.

Do not let water or other liquids get in the product. The product is not protected by jets or splashing water.

The product is sold in the form of a KIT with all tested components. The controller can be used also with third-party components (probes and fans) taking responsibility to connect it. In the manual there are brief explanations about the connection.

The product is powered at low voltage 5-12v; however, pay close attention making connections.

The producer assumes no liability for damage caused by third parties.

1 Overview on SmartPID BBQ

1.1 Scope and Purpose

The purpose of this manual is to describe in detail the installation process and configuration of SmartPID BBQ PRO controller, its application functions and remote control app.

1.2 Technical characteristics

The following table sums up SmartPID BBQ technical characteristics.

FUNCTIONS	SmartPID SPC1000
Control channels	1 PIT & 3 FOOD
Control mode	Monitor/Manual/Auto/Advanced
Fan control	PID-PWM with modulation 0-100%
Probes type	NTC 100 K @ 25c
Beta configuration (NTC)	YES multiple values
Fans support	PWM 4-wire
Unit of temperature	Celsius/Fahrenheit
Sensors calibration	YES
Precision	1%
Resolution	1C
Temperature range	0-220c
Power supply	5-12v DC
220V/110V AC Power supply	YES with external adapter
Battery power supply	YES 5V USB bank for outdoor usage
Controller box measurements	70 x 75 x 50
OLED graphic display	1,3"
USB port	YES
SD Card	YES micro
Wi-Fi connection	YES

Configuration/remote management	YES with universal web app (chrome, firefox, safari)

WI-FI module features

IEEE 802.11 b/g/n Wi-Fi

Authentication WEP or WPA/WPA2, or free networks 802.11 b/g/n

Wi-Fi Direct (P2P), soft-AP

Integrated TCP/IP protocol

Integrated TR switch, balun, LAN, power amplifier

+19.5dBm output power in 802.11b mode

Power down leakage current of <10uA

Stand-by power consumption < 1.0mW (DTIM3)

KIT contents

1.3 Hardware Description

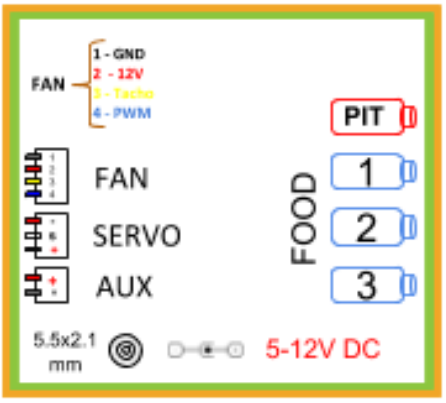
SmartPID BBQ PRO is made up of 2 main boards assembled and inserted in a small 75x70x50 box.

On the front panel there is the 1,5" OLED graphic display, buttons for user interface interactions.

On the side there are USB port for Firmware/data upgrade, microSD card slot and reset button.

Again, on the right side there are four 2.5mm jack for temperature probes connection (1 PIT + 3 FOOD). On the left side instead, there are connectors for PWM 4 wires fan connection and for servo-assisted valve [for a further relief] and auxiliary output.

On the front there is the 5.5x2.1mm power connector instead.



The 4 front push buttons are used for several tasks:

	a) UP/DOWN a. Scroll configuration menu b. Increase/decrease temperature value c. Increase/decrease fan speed d. Scroll values on configuration menu a) SET e. Select/confirm a specific menu f. Select/confirm a specific value g. Confirm the action after request b) Start/Stop h. Start process i. Stop process j. Long press to exit the current menu

2 Hardware Configuration

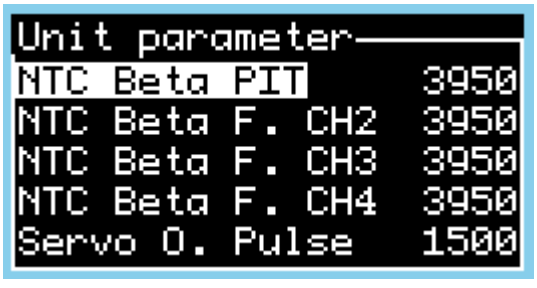
SmartPID BBQ PRO hardware configuration is quite simple and consists in connecting temperature probes included in the kit, PWM 4-wire fan and supply.

2.1 Probes Connection

SmartPID BBQ PRO is equipped with 4 independent channels for the temperature of the grill (1 x PIT) and of food (3 x FOOD) control.

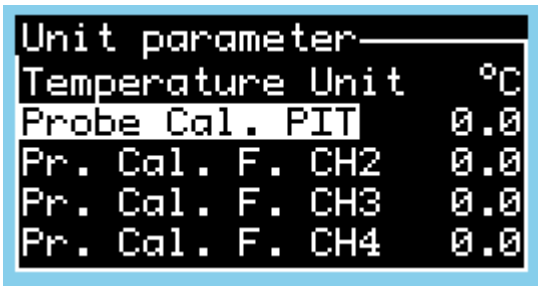
Type NTC probes use 2.5mm connectors.

From the HW configuration menu, you can select “beta” value for each channel.



Supplied probes in the KIT have a beta value equal to 3950 (default value).

Finally, it is possible to make a temperature calibration, read by the probe with positive or negative offset up to 5°C independently on each channel.

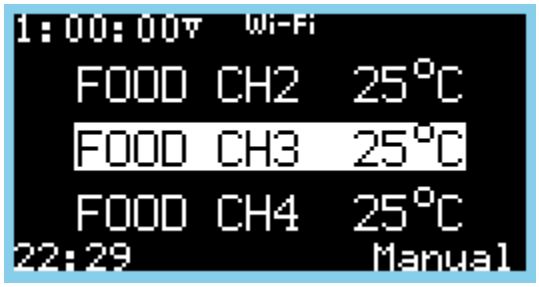


2.2 FOOD Master

SmartPID PRO controller features 3 inputs for temperature probes, one of these inputs assumes the role of FOOD MASTER. All advanced control functions requiring a "food" temperature value, always relate to FOOD MASTER.

From HW configuration menu it is possible to determine which of 3 food channels is MASTER to controller ignition.

During the control process it is always possible to change the assignment of food master, both from the menu and from the remote control web app.

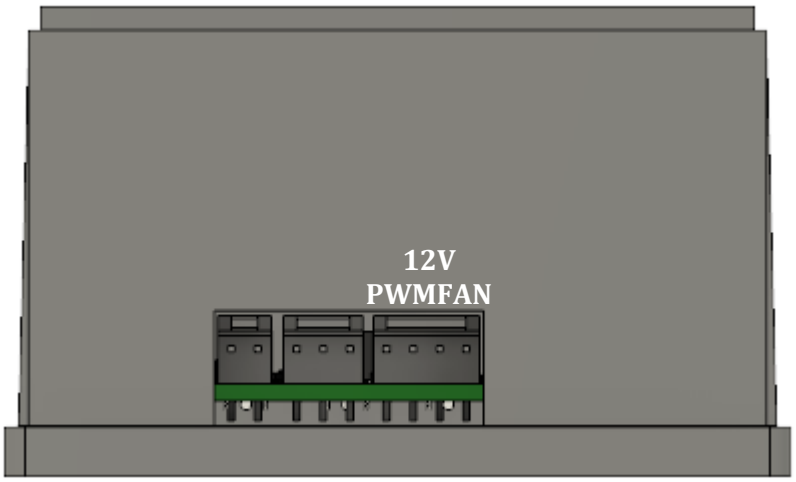


During run mode, to change default assignment you should press SET button and then select with Up/Down buttons master probe and confirm again using SET button.

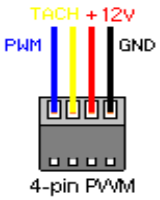
2.3 Fan Connection

SmartPID BBQ PRO supports 12V DC 4-wire fan with speedometer and PWM speed control.

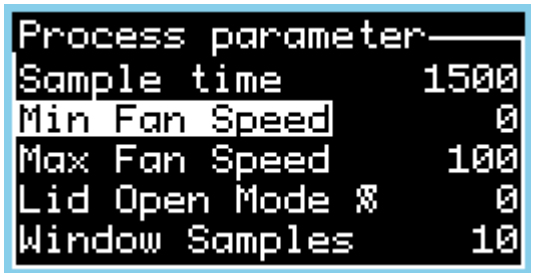
The kit is provided with a pre-configured PWM 4-wire fan.



Fan connector has a direction of insertion, pay attention to tabs without stressing the connector.

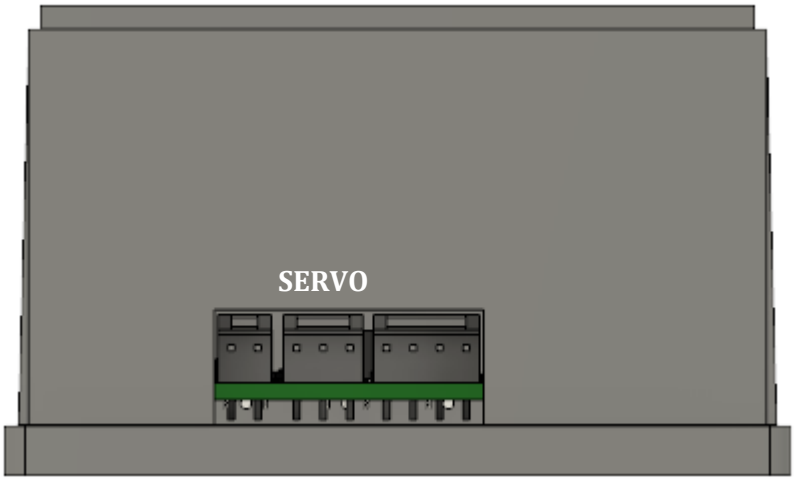


It is possible to establish the operating range of the fan by limiting the maximum and minimum fan speed, acting on **Min/Max Fan Speed** parameters in "Process Parameter" configuration menu. By doing so the fan can be adapted to your own system, setting out a "virtual" fan with a limited scope compared to actual maximum capacity.

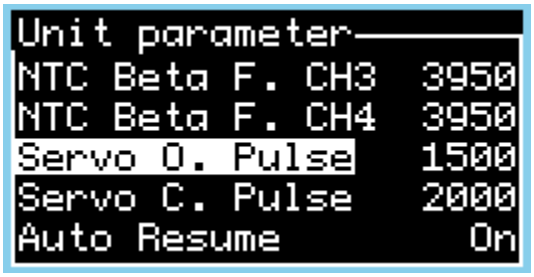


2.4 Servo / Aux Configuration

SmartPID BBQ PRO controller also comes with an output for the control of a servomechanism (mechanical control of fans) and of an auxiliary output 12V DC (for instance to check an electro valve).



In the configuration menu of process parameters, you can define the rotation angle of the servomechanism.



Please Note: servo assisted valve is provided as an accessory and it is not in the KIT's initial equipment.

3 Operating Principle

SmartPID BBQ PRO controller operating principle is based upon the control of airflow over coal to increase or decrease the temperature inside the cooking chamber.

The greater air/oxygen supply, the higher the temperature.

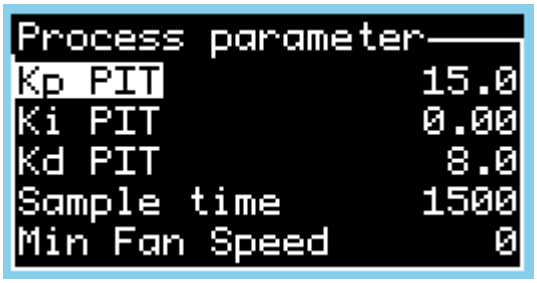
Automatic check is done by constantly tracking the temperature on PIT channel and by continuously modulating fan speed, thus air flow, from 0% to 100% by means of the PID – PWM algorithm.

Such control allows to keep temperature in the cooking chamber at a constant and predetermined value in a stable and clean manner.

The PID – PWM algorithm will adjust fan speed always in 0-100% range but the actual value of rotation speed will be scaled accordingly, depending on MIN/MAX fan speed.

Essential parameters regulating PID algorithm operation are Kp, Ki and Kd constants.

Please refer to a proper tutorial for the calibration process of such values.

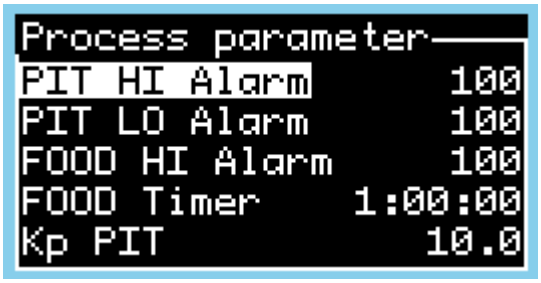


4 SmartPID BBQ PRO Advanced Features

SmartPID BBQ controller is equipped with an array of advanced features in support of cooking process, hereafter is the description and guide to related parameters configuration.

4.1 Alarm Thresholds

PIT and FOOD MASTER channels are characterised by a set of temperature thresholds to which specific alarms and notifications are linked. These values are defined by process parameters and can be modified during run mode by pressing S/S button and UP/DOWN buttons.

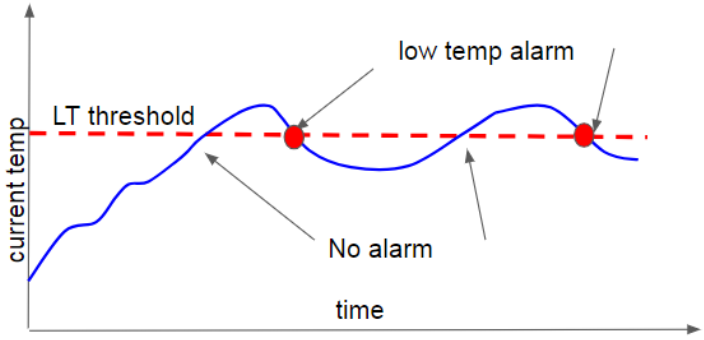


- PIT HI Alarm

  Indicates a maximum threshold temperature value of channel PIT and **in automatic run mode is the set point target value for PID algorithm.**

- PIT LO Alarm

  Indicates a threshold value on PIT channel that causes an alarm if current temperature drops below such value (depletion of coal). Such alarm is not triggered if temperature did not formerly go over cut-off point.



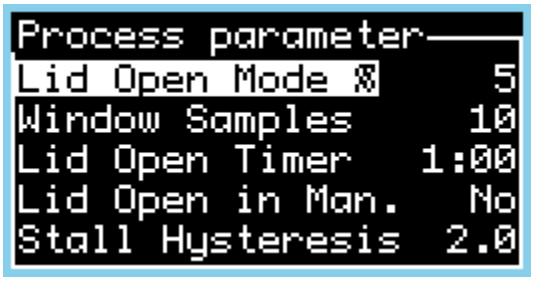
- FOOD MASTER HI Alarm

  Constitutes the target value of FOOD **MASTER** channel, namely the achievement of cooking food temperature. Once is reached, the event is notified and a countdown timer is activated. If configured, is moreover activated the rest mode (see after).

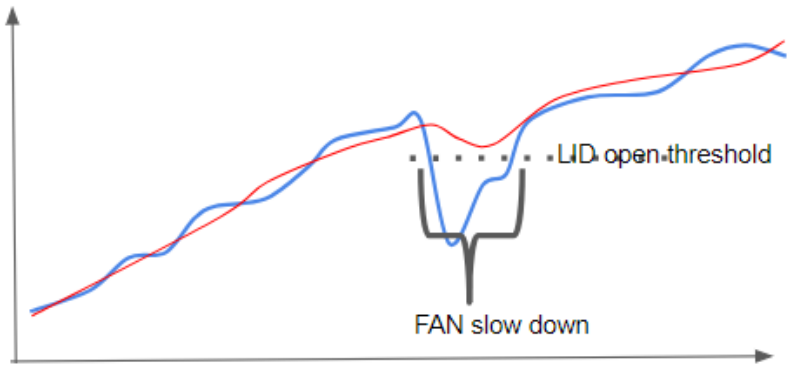
4.2 Lid Open Function

"Lid open" function enables to automatically intercept lid open with subsequent sudden decrease of grill channel temperature, preventing unwanted fan speed boost.

The algorithm is ruled by two parameters which indicate percentage variation of temperature and the term of observation window expressed as sample numbers of sampling window.



In case of % temperature variation over the observation period, fan is brought to MIN FAN speed value for a configurable period of time (Lid Open Timer).



It is even possible to enable/disable LID OPEN mode manually, by simultaneous pressing of UP+SET.

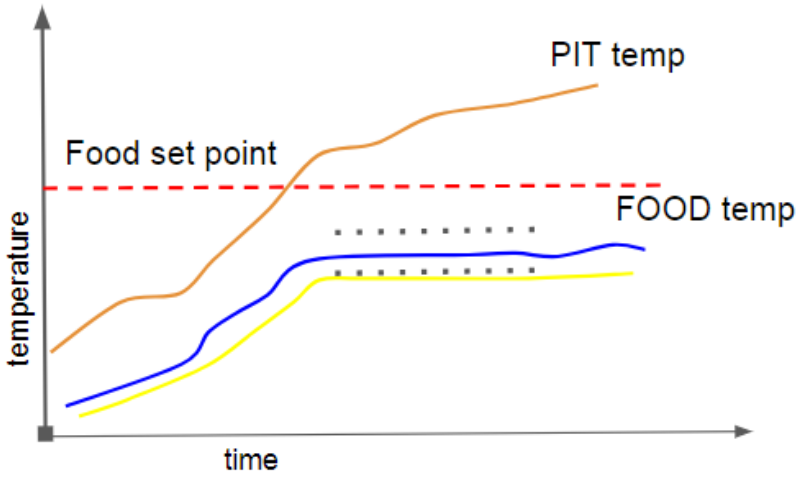
Once finished the LID open timer (or when is reached the set point) the fan is reactivated and monitored again by the PID-PWM algorithm.

Lid Open Mode % = 0 disables monitoring.

It is even possible to use this function in manual control mode, in such case as well the fan will be forced to MIN fan speed in the event of lid opening.

4.3 Stall Function

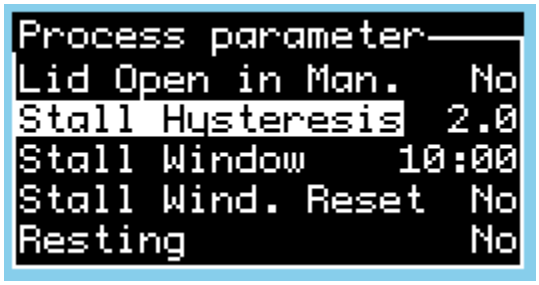
Stall function is applied on FOOD MASTER channel and enables to detect a potentially harmful situation in which core temperature does not increase in a predefined observation interval.



Stall function just provides an indication of audible and visual alarm, no action is performed on the fan. When temperature starts to rise again, it exits stall mode.

Stall function is enabled in all three modes Monitor/Manual/Auto.

Stall function is active before reaching set point on FOOD MASTER channel (FOOD Alarm HI).



Stall function is regulated by hysteresis parameters i.e. a minimum range of temperature variation and by the duration of observation window. If core temperature does not rise at least by hysteresis stall, the stall is notified in stall window.

Stall Hysteresis = 0 control is not applied.

4.4 REST Function

With this function, once reached the FOOD channel set point (Set Point HI), fan speed is automatically brought to MIN fan speed value, despite current temperature value on the grill and related set point.

The function, reached the cooking core optimum temperature, allows to minimise the temperature in the cooking chamber.

4.5 Differential cooking function (Control mode Advanced)

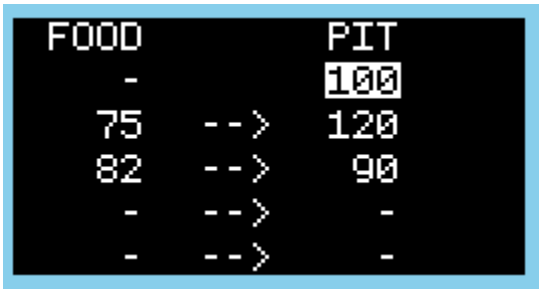
"Differential cooking" function enables to track the cooking chamber temperature on the basis of food's core temperature.

Therefore, actual cooking programs can be created, with temperature profiles complex at will.

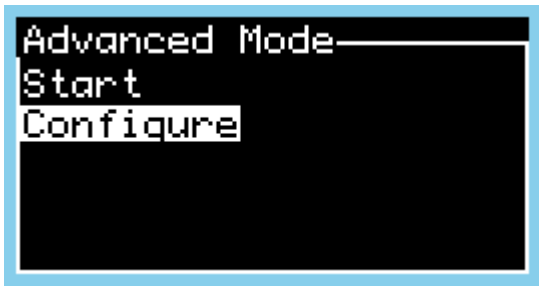
To each FOOD MASTER temperature value, a target value of PIT temperature is associated. Once you've reached the value on FOOD MASTER channel, the set point on PIT channel is automatically changed.

The fan management by means of PID-PWM happens consequently the change of PIT channel set point.

It is possible to define a profile with up to 4 temperature steps.



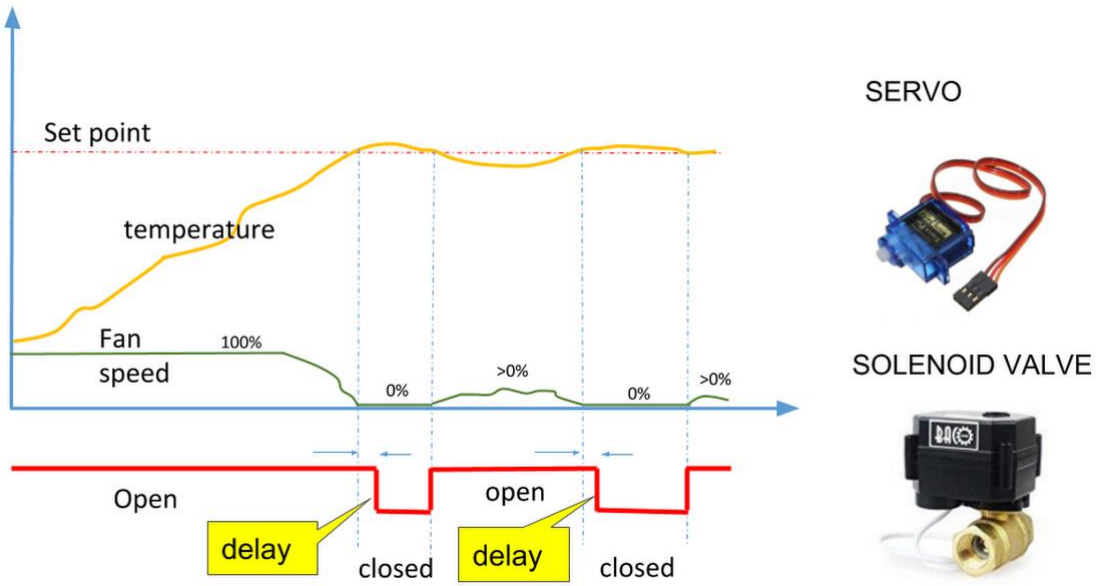
Profiles configuration is essential before starting the advanced control mode by entering the configuration menu.



4.6 Servo/Electro valve Management

By means of this function, once achieved in AUTO operation mode, the set point on PIT channel and consequently of PID-PWM = 0% (min fan speed), it is possible to seal the air supply (vent-in) in order to avoid the chimney effect and thermal drift in the combustion chamber.

To handle the lock of vent-in you need to insert a servomechanism that moves a slider or an equivalent regularly closed electro valve.



You can set in process parameters the lag between the stop of the fan and the servo/electro valve closure.

In case of servomechanism usage, it is possible to set the starting and rotation angle of the same, by means of two parameters in the unit parameter configuration menu.

5 Configuration Parameters

The following table sums up configuration parameters in process parameter menu.

Parameter	description	Value	default
PIT Alarm	PIT channel temperature threshold default values -HI Alarm (set point value in AUTO run mode) -LO Alarm	0-300	100
FOOD Alarm	FOOD **MASTER** channel temperature threshold default values Cooking core target temperature	0-300	100
FOOD timer	Timer/count down to the achievement of channel PIT set point	0-24h (in min)	60min
Kp Ki Kd PID	Calibration constants of PID algorithm	0-100	15/0/8
Sample Time	Temperature sampling time	1000-4000 ms	1500
Min fan speed	Minimum fan speed in % on maximum rotation speed	0-100	0%
MAX fan speed	Maximum fan speed in % on maximum rotation speed	0-100	100%
Lid Open Mode %	% of current temperature variation to get to Lid open mode **0% disabled function**	0-20%	0%
Windows Sample	Number of samples used for calculating the moving average in the Lid Open algorithm. The duration of window is defined by the sample time parameter	0-10	10

Lid Open Timer	Duration of Lid Open period	0-5min	1min
Lid open in manual	It determines if Lid open mode is used also in MANUAL control mode	Y/N	N
Stall Hysteresis	Minimal variation in absolute amount of FOOD temperature to identify the stall condition **0c disabled function**	0-6c	0c
Stall Window	Duration of observation window in minutes for stall algorithm	1 - 30	10
Stall Window reset	Determines whether once out of the deadlock the calculation goes to zero or is resumed by previous sample	Y/N	N
Vent-IN cl. delay	Defines delay time in seconds for servo (or electro valve) closure as soon as the fan stops	0-30	10
Resting	Enabling rest function when the HI threshold is reached on FOOD channel	Y/N	N
Sound Alarm	Allows to enable/disable audible alarms		

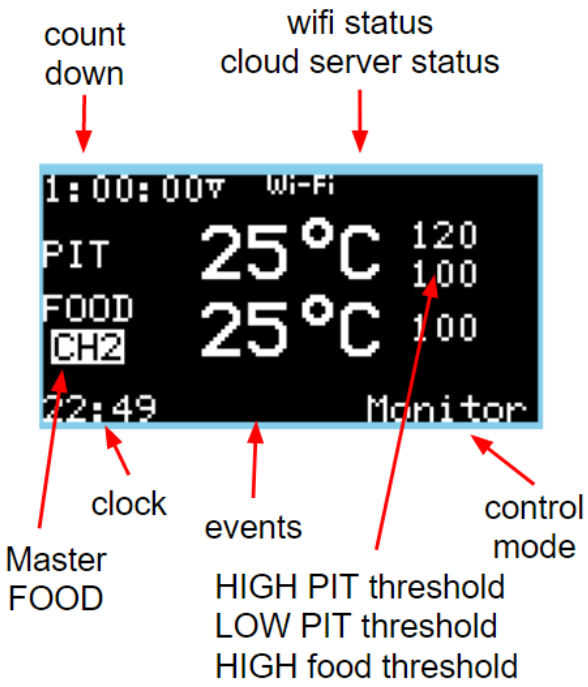
6 Mode of operation

SmartPID BBQ disposes of 4 operation modes

1. Monitor
2. Manual Control mode
3. Auto Control mode
4. Advanced Control mode

6.1 Monitor

In monitor mode the SmartPID controller is limited to display 4 channels temperatures and can thus be used as a "thermometer". Threshold values on PIT and FOOD MASTER channel trigger alarms and notifications on the remote app. No check is carried out on the fan.



Operativity through the 4 buttons is the following:

- UP/DOWN

  select FOOD channel to be displayed (FOOD MASTER channel is indicated with a black on white inversion of the text). As you select FOOD MASTER channel, it appears the related food high threshold too

- SET

  switch from text to graphic mode and pick of FOOD MASTER probe

- SET long press

  changes count down timer duration (up/down)

- S/S

  select the threshold value to be changed (PIT HI/LO, FOOD HI)

- S/S long press

  stop the process and back to main menu

6.2 Manual Mode

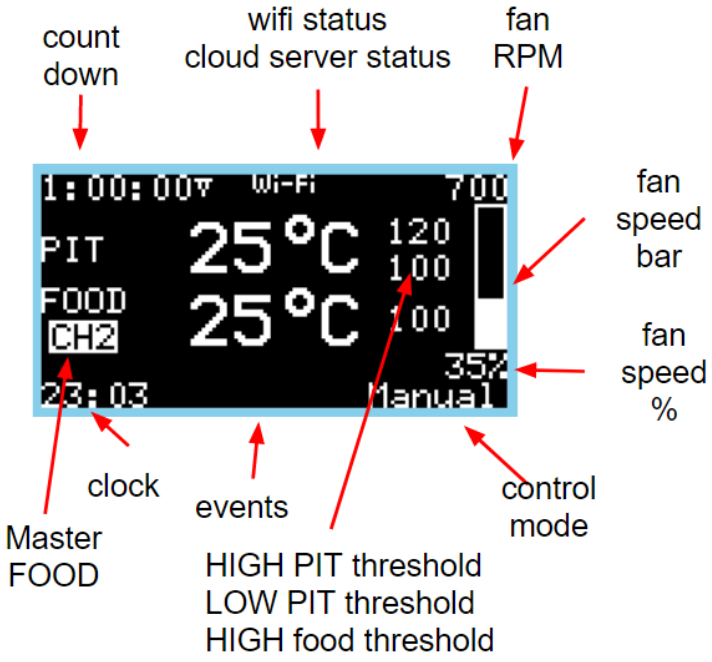
In manual operating mode it is possible to check the fan speed by setting a fixed value from 0 to 100%.

By repeatedly pressing SET button you get to the fan control screen and with UP/DOWN buttons you can modify the fan speed.

Please note how the % of fan rotation is always relating to the range defined by MIN fan speed – MAX fan speed in configuration parameters (process parameter).

The number of rotations per minute (RPM) is therefore reported in absolute value.

If Lid Open in manual function is enabled, you can automatically force the fan to MIN fan speed, at the opening of the lid or by the UP+SET pressure.



Operativity through the 4 buttons is the following:

- UP/DOWN

  select FOOD channel to be displayed (FOOD MASTER channel is indicated with a black on white inversion of the text). As you select FOOD MASTER channel, the related food high threshold appears too

- SET

  switch from text to graphic mode, FOOD MASTER change of assignment mode and to fan manual control

- SET long press

  change count down timer duration (up/down)

- S/S

  select the threshold value to be midified (PIT HI/LO, FOOD HI)

- S/S long press

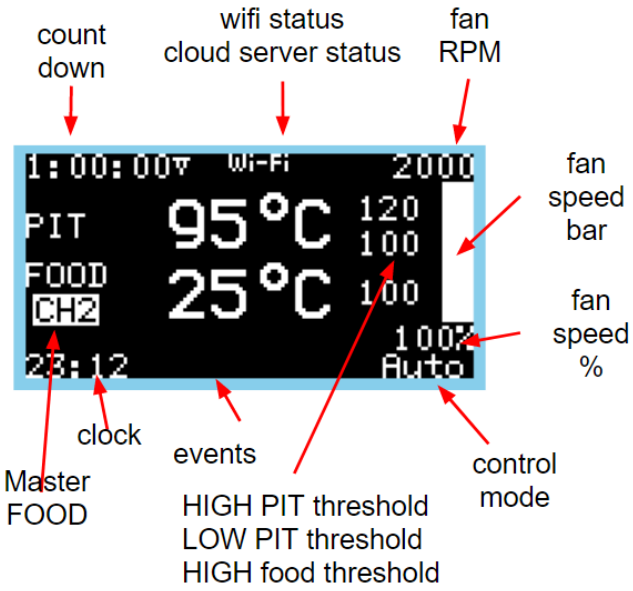
  stop the process and back to main menu

6.3 Auto Mode

In this mode the PID-PWM algorithm handles entirely the fan so that it can reach the predefined set point on channel PIT (PIT HI alarm) and to keep the temperature consistent.

In such mode you can intervene at any time to change PIT and FOOD MASTER thresholds by pressing S/S button and using UP/DOWN buttons.

In automatic operating mode, if configured in process parameters, several advanced functions are active (Lid Open, Stall, etc.)



Operativity through the 4 buttons is the following:

- UP/DOWN

  select FOOD channel to be displayed (FOOD MASTER channel is indicated with a black on white inversion of the text). As you select FOOD MASTER channel, the related food high threshold appears too

- SET

  switch from text to graphic mode for PIT and FOOD channel, and to change of FOOD MASTER assignment mode

- SET long press

  modify count down timer duration (up/down)

- S/S

  select the threshold value to be changed (PIT HI/LO, FOOD HI)

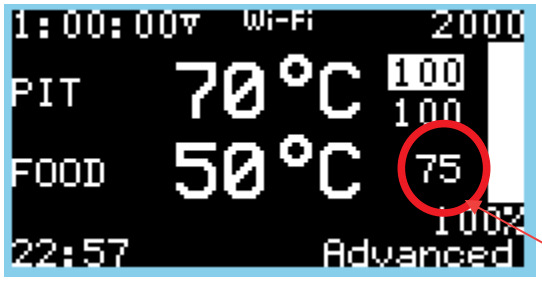
- S/S long press

  stop the process and back to main menu

6.4 Advanced Mode

In advanced operating mode you need to select a differential cooking program (see paragraph 4.5). SmartPID BBQ then runs the program monitoring the FOOD MASTER channel temperature and consequently modifying the PIT channel set point.

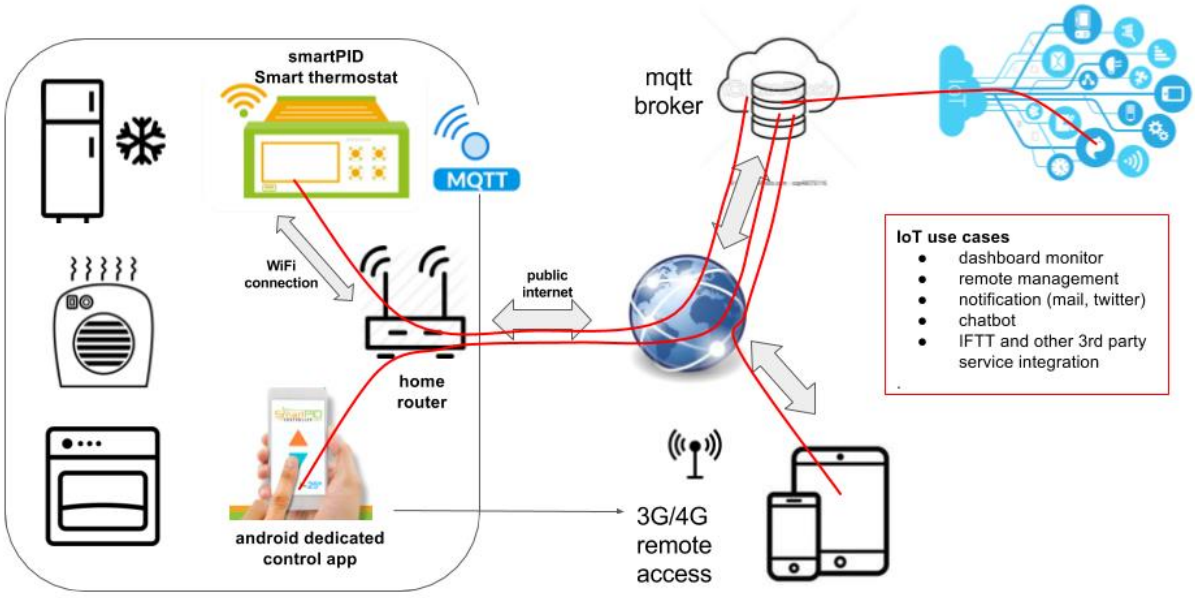
In this mode it is NOT possible to manually modify the FOOD HI threshold value, given that it is predefined in the cooking program. It is possible instead to change HI/LO threshold of PIT channel.



Operativity through buttons is the same as the AUTO mode.

7 Wi-Fi Connection and remote management

SmartPID BBQ controller is equipped with a Wi-Fi module that enables to connect to home Wi-Fi network and from here through public Internet to a dedicated server.



Such architecture allows a number of remote functions using a dedicated App (Android)

- Monitoring parameters

  You can remotely monitor main parameters during one of the operating modes (Monitor/Manual/Auto/Advanced). With a configurable frequency specifically, the following parameters will be sent to the app:

  - PIT and FOOD channels temperature
  - HI/LO thresholds
  - Fan Speed
  - Operating mode

- Events/Notifications

  SmartPID BBQ controller notifies to the remote App main events while running a control mode:

  - Start/Stop process
  - Reaching thresholds HI/LO on the two channels
  - Lid Open Event
  - Stall Event
  - End of Count Down

- Controls

Through the app you can interact with the SmartPID BBQ controller changing some of the main parameters:

  - HI/LO alarm thresholds (set point)
  - Select FOOD MASTER channel
  - Countdown duration
  - Forced opening of the lid

- Profiles

By means of the App it is possible to set in a simple way differential cooking profiles and to save them on SmartPID BBQ controller.

For Wi-Fi configuration and connection to remote server see the step by step guide.

8 WEB APP

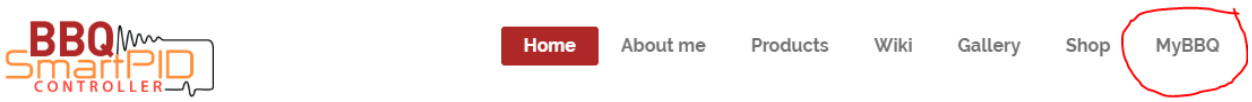
SmartPID BBQ PRO controller can be managed by the use of a simple web app compatible with all main desktop and mobile browsers (chrome, firefox, safari).

To access the web app, you just need to open the following link in your browser bar

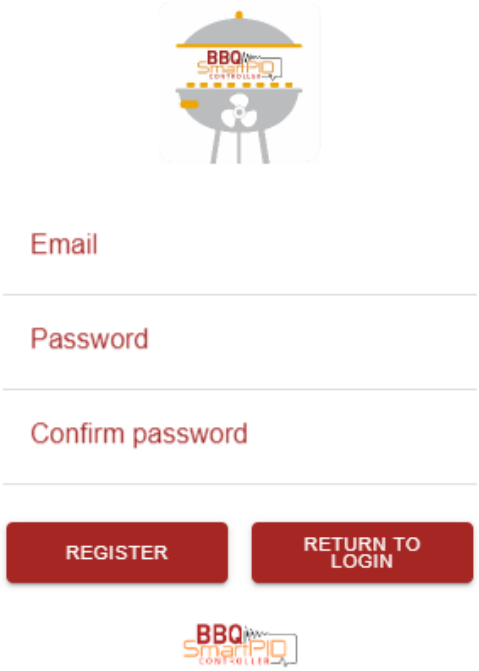
https://mybbq.smartpid.com/

Or to click on MyBBQ menu in the official website

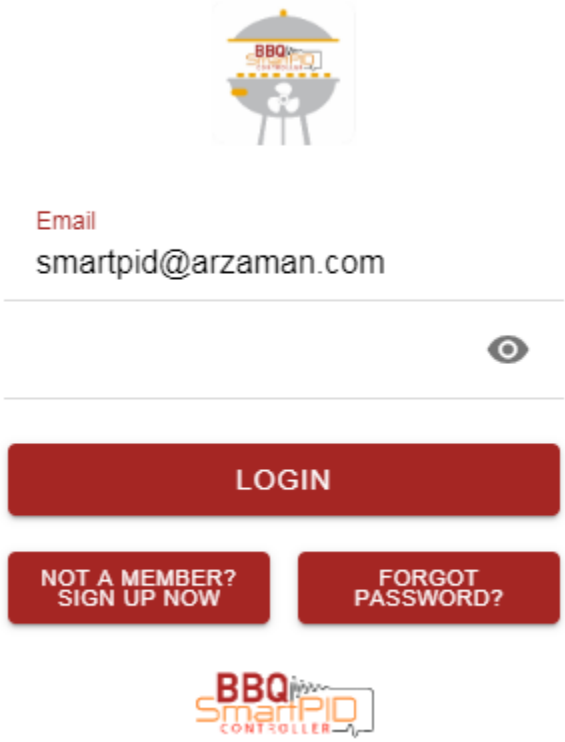
https://bbq.smartpid.com/



To be able to use the App you have to go through the initial registration process (sign up) entering a valid email address and an access password.

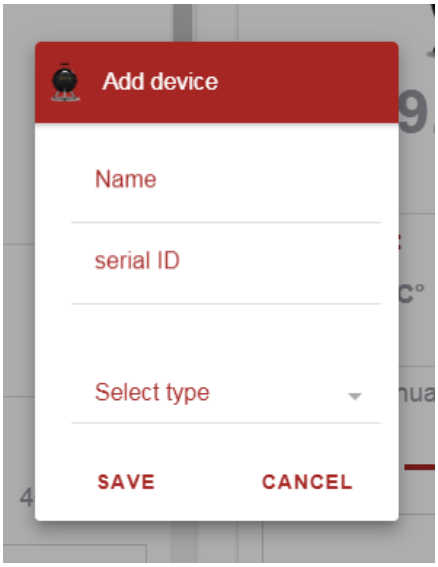


Once registered your credentials you can log into it (Login).



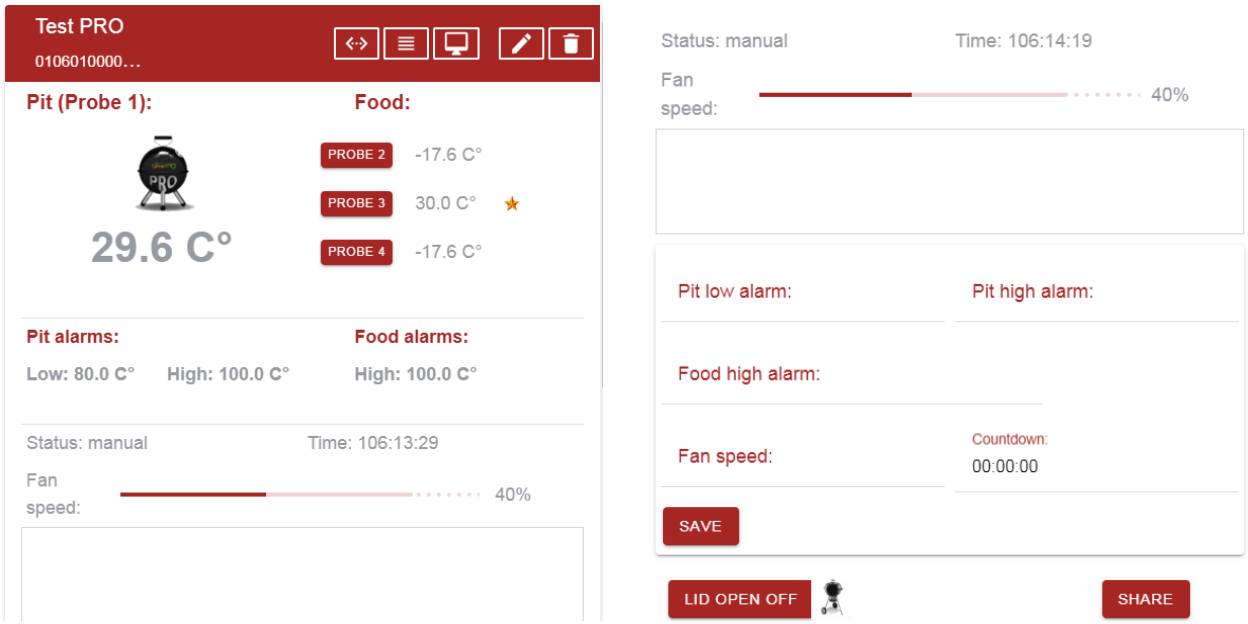
At this point you have to configure your SmartPID BBQ (+ button) controller assigning an identifying name and entering the 14-digit serial (available in controller's INFO menu).

You need to select the "PRO" type of controller



It is possible to manage more controllers with the same Web App as well as to have more App to simultaneously monitor the same controller.

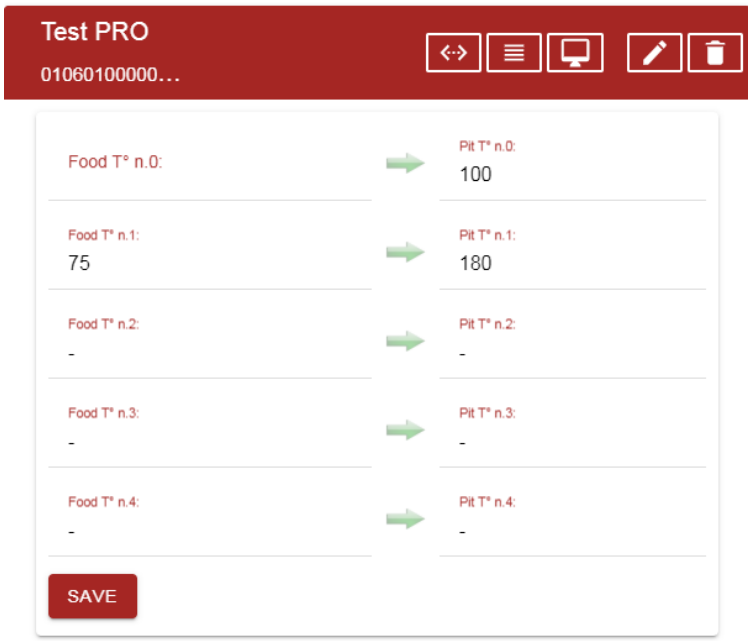
Once configured the controller, if it is connected to Wi-Fi network and is in one of the 4 operating modes (Monitor/Manual/Auto/Advanced) the App will start to receive data and parameters that will be displayed on the main screen.



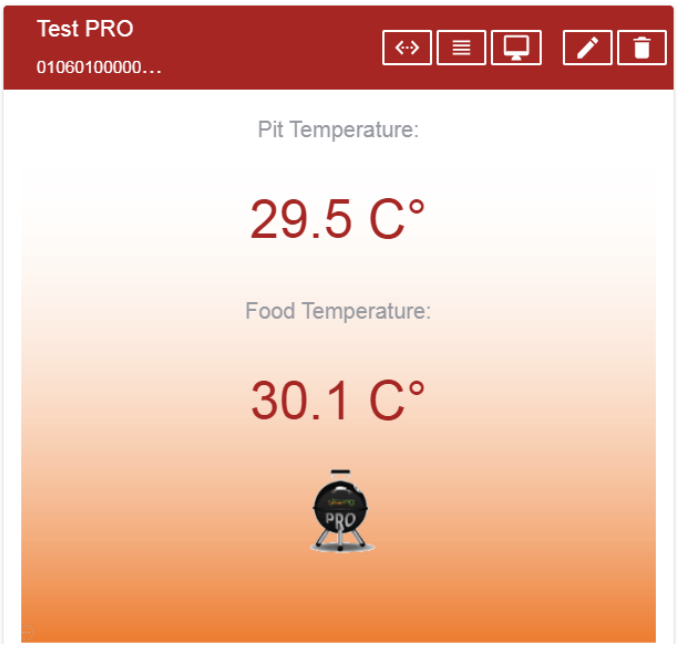
In the notification area the different alarms and asynchronous notifications will be displayed, sent by the SmartPID BBQ PRO controller.

Again, from the main screen you can give commands to change thresholds or to force Lid open mode.

From “profile” tab you can set profiles for advanced cooking mode that will be saved on the controller by *save* button.

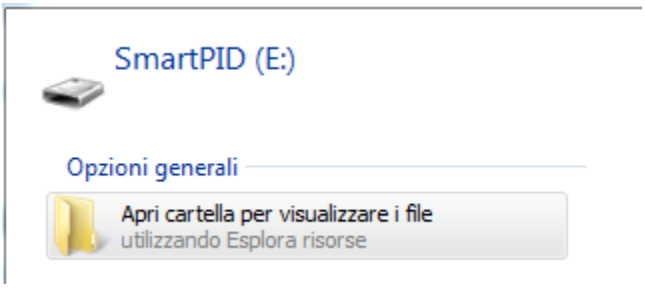


From “full display” tab you have a full screen view mode of PIT and FOOD MASTER probe temperature data.



9 Firmware Upgrade

Firmware upgrade can be easily run using the bootloader technology of the MSD mass storage device that allows to “copy and paste” the binary file executable into the smartPID BBQ controller linked by USB and recognised as mass USB.



To upgrade the FW, you don’t need any driver or SW installation, you just have to follow the steps below.

FW upgrade deletes existent configurations, hence we suggest to take note of modified parameters. To the completion of the upgrade, you need to reconfigure the controller and to do again the Wi-Fi configuration process.

1. Connect a micro USB DATA cable to a PC (Windows/Linux/MAC) USB port (beware, on the market there are cables for charge only, which do not support data)
2. Disconnect smartPID from all (probes, fan, power supply)
3. Plug the micro USB connector into the SmartPID front socket holding down the S/S button: OLED display will be enlightened by a white colour
4. Release the S/S button, smartPID will appear on the PC as mass storage device and OLED display will toggle between black and white colour
5. Remove the FLASH.BIN file present on the device
6. Copy the executable.bin file of the new application into the mass storage device
7. **Safely remove** the USB mass storage device from the PC
8. Restart SmartPID and verify the correct SW version on the BOOT screen
9. Reconfigure parameters

10 Restore factory settings

It is possible to restore app settings to default factory settings (internal EEPROM deletion) by the following procedure.

Switch SmartPID powering it with the back power supply or with the front USB holding the **DOWN** button: OLED display will show the message “Init EEPROM” which indicates that the app settings have been restored to default settings; after a few seconds, the application will start with default settings.